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THE LEADING MAGAZINE FOR THE INTERNATIONAL FLAT GLASS INDUSTRY

May/June • Year 31 • No. 3/2020

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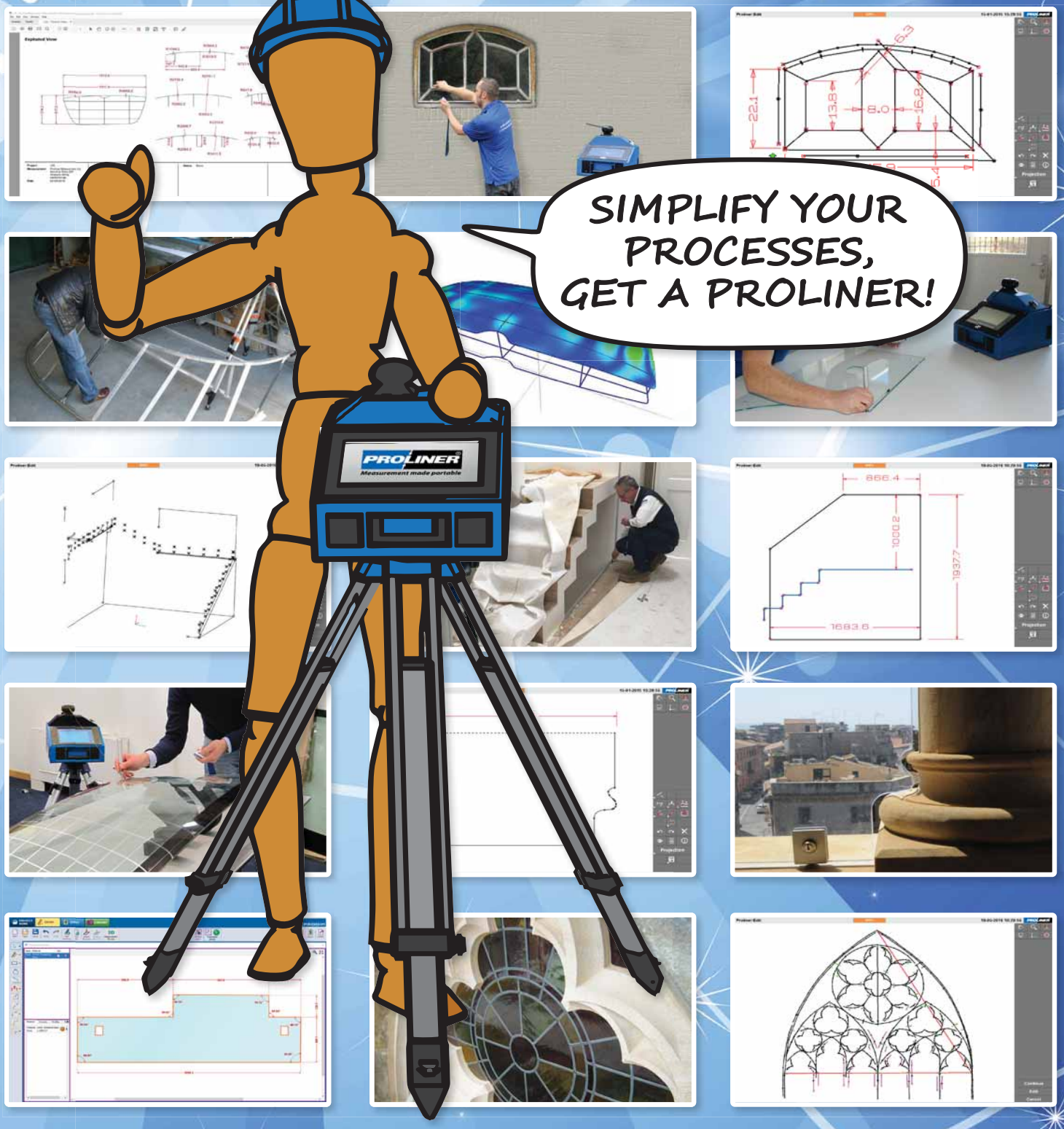

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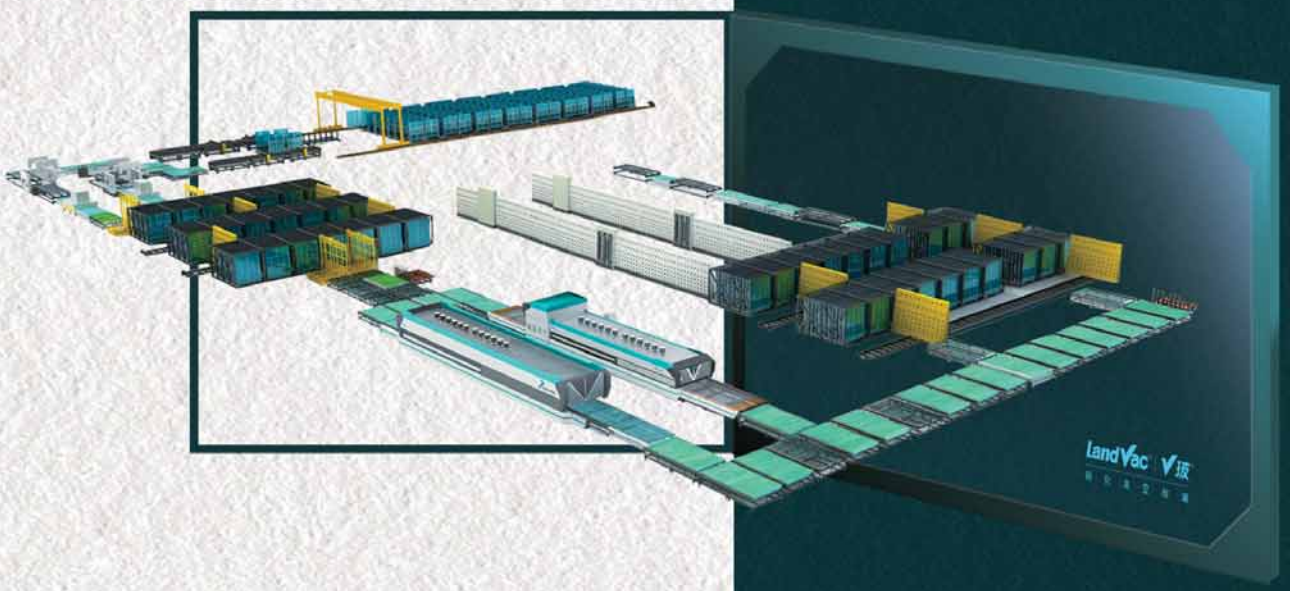

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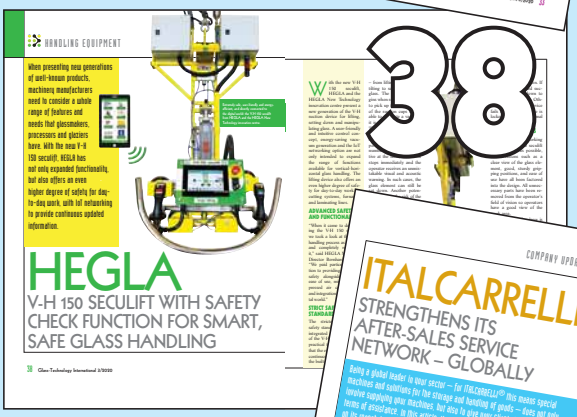

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2020 FAIR CALENDAR

The magazine will be distributed at the following Trade Fairs

issue	exhibition/conference	date	venue	deadlines
2020 1	GLASS MIDDLE EAST EXPO	27-29 February	CAIRO Egypt	
	EURASIA GLASS	4-7 March	ISTANBUL Turkey	
	ICCG	Postponed 2021	BRAUNSCHWEIG Germany	
	FENSTERBAU FRONTALE	Postponed 2021	NURENBERG Germany	
2020	FLATGLASS 2020 world directory			
2020 2	CHINA GLASS	Postponed 2021	SHANGHAI China	
2020 3	GLASS SOUTH AMERICA	Postponed 24-27 March 2021	SÃO PAULO Brazil	
	MIR STEKLA	Postponed 7-10 June 2021	MOSCOW Russia	
2020 4	GLASSTECH MEXICO	Postponed 2021	GUADALAJARA Mexico	
	GLASSBUILD AMERICA	15-17 September	LAS VEGAS (NV) USA	
2020 5	GLASSTEC	20-23 October	DUSSELDORF Germany	Editorial files: 04-09-2020
	ALL GLASSTEC EXHIBITORS ADVERTISING IN THIS ISSUE ALSO RECEIVE A FREE GLASSTEC PREVIEW			Deadline Adv files: 18-09-2020
2020 6	VETECO	10-13 November	MADRID Spain	
	GLASSTECH ASIA	17-19 November	BANGKOK Thailand	Editorial files: 02-10-2020
	ZAK GLASS TECHNOLOGY	3-6 December	MUMBAI India	Deadline Adv files: 16-10-2020

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LiSEC

Participation in CERICOM

Through participation in **CERICOM** – formerly *Cerion Laser GmbH*, the specialist for the laser processing of glass – **LiSEC** is expanding its competence in offering innovative solutions for the processing of flat glass and technical glass lites sheets by means of laser.

The laser activities of the LiSEC Group are concentrated within Lascom Laser GmbH, with a focus to date on the laser processing of hollow glass. Lascom Laser GmbH has now taken over the insolvent Cerion Laser GmbH for strategic reasons and will continue to run the business within the framework of the successor company CERICOM GmbH, based in Minden.

With the successor company CERICOM (Lascom Laser GmbH 74%, LiSEC Holding GmbH 26%), the LiSEC Group now has also access to the consolidated innovative power of laser processing in the area of flat glass and technical glass lites sheets. In the future, developments in the laser sector will be driven forwards on a common basis, in order to offer innovative and practical solutions in glass processing to glass processors around the world.

CERICOM is a pioneer and specialist in technologies for the laser processing of glass. The company has been developing laser machines since 2002, and can therefore offer highly specialised solutions for the internal engraving, marking, drilling and cutting, as well as matting, edge deletion and structuring of all types of glass coatings.

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NGA

Glass Conference to transition to Interactive online event

The National Glass Association (**NGA**) has announced it will shift its NGA Glass Conference: Chicago to an interactive online event to take place 28-30 July 2020. Due to the COVID-19 pandemic implications and many company-enforced travel restrictions, the event previously planned to take place in Northbrook, IL, USA, will now be hosted via private online video conference using the Zoom platform.

"NGA's technical and codes work has continued to move forward unabated and we want to share that important work, and the resources that come from it, with our members and the industry," said Nicole Harris, NGA president & CEO. "NGA has reimagined the NGA Glass Conference in a robust online format that will be both engaging and productive and that will allow us to reach new participants who may not have had the opportunity to attend the in-person conference."

Participants can expect a mix of essential NGA Forming, Fabricating and Advocacy Committee updates paired with excellent educational content, including the popular technical and codes update. There will be opportunities for participants to engage in live Q&A with presenters.

Select sessions will also be AIA-accredited with the goal to encourage more architects to learn about glass and to aid in the fulfilment of required learning units that may have been impacted by the recent cancellation of the AIA Conference on Architecture.

Registration will open the week of May 18. Members and non-members are welcome and encouraged to attend.

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GLASTON

Insulating glass technology for Uniglass Polska

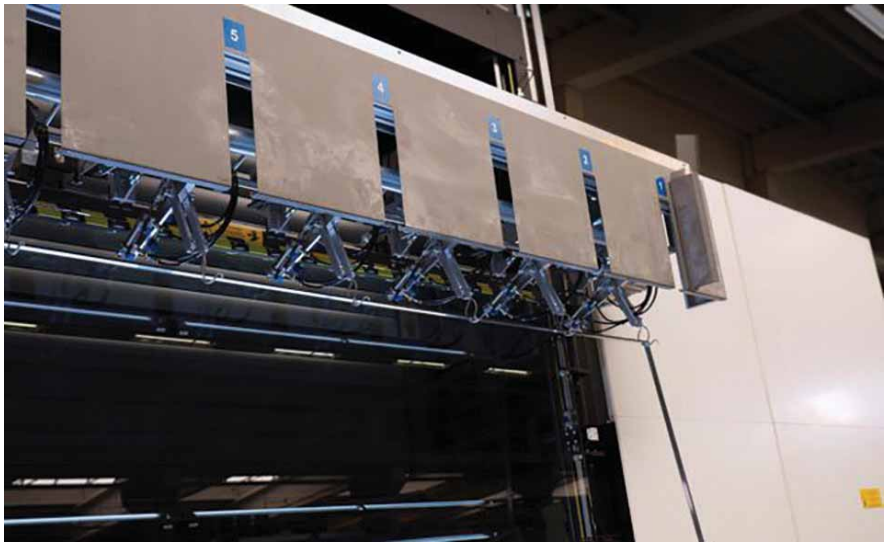
Uniglass Polska, a company that mainly produces insulating glass, was looking for a solution that in addition to increased capacity would enable a higher degree of automation in insulated glass manufacturing. When the company was looking for a partner for a series of investments for their new production facility in Łomża, **Glaston** was well positioned to meet the customer's requirements.

For processing of façade units, the customer's choice was the B'JUMBO insulating glass line especially designed for manufacturing large-sized insulating glass units and façade elements. The line also contains new, automatic process steps for efficient and safe production.

"This project is another step to increase the rate of automation in the insulating glass unit (IGU) production. With the new line the customer can increase the productivity and efficiency, they can ensure a high-quality level of their IGU's and in addition, increase the safety level for the operators. Eventually this will help the customer to lower the production and maintenance costs," said Marco Stehr, head of Glaston sales in Europe.

The total order also includes a B'VARIO 270 insulating glass line, the individually configurable production line for insulating glass units with conventional spacers, as well as an arrissing machine and handling equipment. The orders are booked in Glaston's Q1 and Q2 2020 order book and the Q1 orders were included in Glaston's January –March 2020 Interim Report. The IG lines are scheduled for delivery in Q3 and Q4 2020.

UniGlass Polska has consistently pursued a dynamic growth strategy in providing high-quality glass and being a reliable supplier with short delivery times for its customers. Since its founding in 2001, Uniglass Polska has relied on Glaston's technology and the company runs several *Bystronic* IG lines as well as one Glaston FC 500 tempering line. Constant quality control and a careful selection of suppliers have enabled the glass processor to develop and to meet the requirements of a wide range of customers in Poland and abroad.



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NGA

Glass in Buildings in Compliance FAQs

The National Glass Association (**NGA**) offers a new resource in the form of Frequently Asked Questions (FAQs) that address compliance of glass in buildings in accordance with the California AB262 legislation, also known as the Buy Clean California Act.

"The Buy Clean California (AB262) legislation has generated a lot of questions about its impact on the use of glass in construction in the state," says Chris Dolan, Guardian Glass and member of the NGA Forming Committee. "We think stakeholders and other interested

parties will find the NGA Frequently Asked Questions a helpful document. It summarizes key elements of the legislation, defines flat glass and processed glass to their respective Product Category Rules (PCRs) and offers guidance on what is required when bidding on California state-funded projects."

The FAQs go into detail on additional topics, including:

- The definition of a public works project and how it fits into CA AB262
- Key legislation dates that affect eligible materials accepted
- Definitions of flat glass and processed glass according to the legislation verbiage
- Requirements to bid on a California state-funded project
- Methods to locate data and address questions surrounding data for Global Warming Potential and compliance with AB262
- And more

"NGA continues to work with the California Department of General Services and other interested parties to clarify the language of the bill—to ensure they understand the effects on public works building projects in California and to provide education about glass and glazing supply," according to Urmilla Sowell, NGA Advocacy and Technical Director.

GLASS.ORG/ABOUT-NGA/ADVOCACY

GLASSTEC 2020

Global trends and innovations

Central questions on the numerous challenges facing the glass industry will be discussed at **glasstec 2020**. In terms of content, everything will revolve around the global challenges of climate change (Climate), scarcity of resources (Resources), advancing urbanisation (Urbanisation), the need for further value enhancement (Value) as well as the opportunities that the material glass offers for increasing the quality of life of people ("Happiness").

What contribution can the glass industry make to master the acute global challenges? The exhibitors, as well as numerous top-level lectures at the glasstec conference and the innovation show glass technology live will be presenting their contributions to solutions at glasstec.

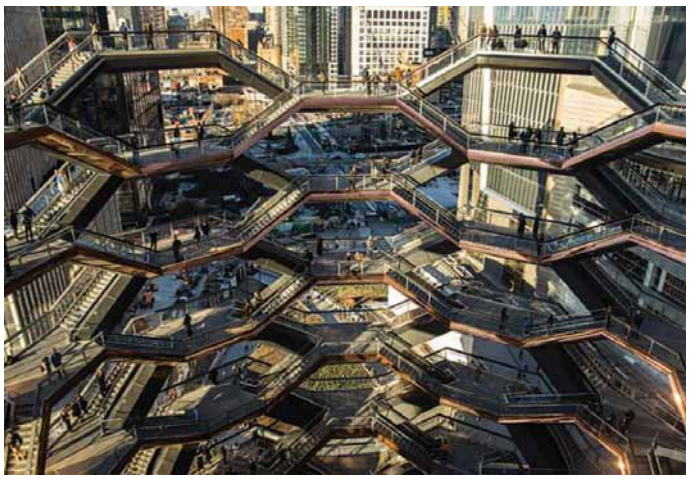
WWW.GLASSTEC-ONLINE.COM

TYROLIT

The Vessel, architectural jungle gym made of glass

The Vessel, an iconic structure and landmark built as part of the Hudson Yards redevelopment project in Manhattan, New York City, USA, won a major prize at the World Architecture Festival in Amsterdam. A note from the jury explained the reason for the award, "People engage with this platform in a new and innovative way. It has clear structural innovation which offers all communities in the city the potential to devise new creative moments in peoples' lives."

Built to plans by British designer Thomas Heatherwick, the elaborate honeycomb-like structure rises over 16 floors and consists of 154 flights of stairs, 2,500 steps and 80 platforms that visitors can climb. The copper-clad steps, which are arranged like a jungle gym and modelled after Indian step wells, can each accommodate 1,000 people. The Croatian company *Formator* safety glass, based in Rijeka, produced the 4,000 square meters of 1010.4 low iron tempered laminated glass with SentryGlas® interlayer. The production of the low iron glass was very challenging, as the tolerances of the shaped glass were very strict. **TYROLIT** took up the challenge and delivered its flat peripheral diamond wheels on vertical CNC machines. Formator employed both segmented and trapezoidal peripheral discs with diameters of 200mm to reach tolerances near zero.



Formator employees working with laminated glass not only benefited from the perfect edge processing, but also from the high feed speed and the optimal start-up of the wheels. In addition, the long service life of these peripheral grinding wheels made fewer interruptions necessary for wheel changes and consequently also brought economic advantages.

WWW.TYROLIT.COM

XAAR

Senior leadership invests in the future

Members of **Xaar**'s senior leadership team have bought shares in the business to underline their commitment and confidence in its new strategy. John Mills, CEO, Ian Tichias, CFO and Andrew Herbert, Chairman, have all invested in the company, buying 275,000 Xaar shares between them. The significant investment follows the announcement of Xaar's full year results yesterday for the 12 months ending 31 December 2019.

John Mills, Chief Executive Officer, said, "Y2019 was a difficult year for the Group as a result of the performance of the Printhead business and decision to end investment in Thin Film.

"However, we entered 2020 with confidence in the long-term future of the business and a revised strategy, product roadmap and strong balance sheet to deliver improved business performance and a return to profitability.

"Clearly, the recent events with the rise of the COVID-19 pandemic mean it is impossible to determine the effect on Xaar's 2020 results; however we are yet to see a significant impact on customer demand.

"We have all the fundamentals in place to continue to execute our strategy and return Xaar to profitability. Our share investment is a clear demonstration of our belief in the long-term performance of the business and the confidence that we have in delivering sustainable growth."

Xaar is a world leader in the development of digital inkjet technology in both architectural glass and automotive glass markets.

From left to right: John Mills, CEO, Ian Tichias, CFO, Andrew Herbert, Chairman

WWW.XAAR.COM/EN

NORTHGLASS

When art meets glass

Tianjin NorthGlass is the only Chinese supplier to appear in the list of suppliers of Denver Art Museum, located in Colorado, USA, for its new Welcome Center. The centre is located between Hamilton Building and the North Building of the museum, as the main entrance of gallery and education projects, it is a joint project of the museum aimed to revitalize the North Building, designed by famous Italian architect Gio Ponti, to strengthen the connection between various functional areas of the museum and to improve the tourist facilities.

The new Welcome Center is an independent elliptical space that cantilevers over the ground. The all-glass façade provides a broad view around the cultural centre and the facade of oversized curved tempered glass creates an elegant surface ripple. The objects around the building reflect on the curved glass and flash a very dreamlike visual effect, creating a new experience.

"The oval glass curtain wall will be used as a structural support for the new welcome centre building, which is a pioneer in North America. There are 52 glass panels in the oval curtain wall, each of which is 25 feet high and 8 feet wide." According to Denver Art Museum, "the Welcome Center forms a sharp arc contrast with Hamilton House on the opposite side of the street, with sufficient natural lighting. Whether you are inside or outside the building, no matter where you stand, you can have a unique view through the 52 curved glass surfaces of the oval structure."

Considering the characteristics of high altitude and strong sunlight in this area, the new Welcome Center adopts 2.5mx7.5m oversized tempered laminated triple-silver low-E insulated glass, which ensures the energy saving effect of large glass panel to the maximum.

At the foot of the Rocky Mountains, the Denver art museum was founded in the 1990s. The original design elements are fused with the new techniques of NorthGlass super glass, reaching the high level of architectural aesthetics. Today, the Denver Art Museum is the newest, the highest and the most modern art museum in the United States.

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PERMASTEELISA

Sold to Atlas Holdings

LIXIL Group Corporation, manufacturer of pioneering water and housing products, has announced that it has entered into a definitive agreement to sell **Permasteelisa S.p.A.** to **Atlas Holdings LLC.**

Atlas and its affiliates own and operate a diversified group of global manufacturing, distribution and construction businesses with a unique emphasis on safety and operational improvement. The transaction is subject to customary closing conditions and regulatory approvals. Terms of the transaction were not disclosed.

Permasteelisa is a leading global contractor in the engineering, project management, manufacturing, installation and after-sales services of advanced building façades, architectural envelopes and interiors. The company has brought to life some of the most iconic buildings defining city skylines today, from the Shard in London to Apple's HQ campus in Cupertino, the World Trade Center redevelopment in New York, where the group worked on 1WTC, 3WTC and 7WTC, through to the World Financial Center in Shanghai and the International Commerce Center in Hong Kong. Operating out of its group headquarters in Vittorio Veneto in Italy, the company has worked with architects around the world on over 3,500 projects to date.

"We are pleased to have reached an agreement that will allow Permasteelisa, a world-class brand in the area of highly specialized curtain walls, to become part of the Atlas family of global businesses. We believe Atlas is the ideal owner for Permasteelisa, as they bring a strong record of delivering the human and financial capital necessary to strengthen businesses for the long-term," said Kinya Seto, CEO of LIXIL Group. "For LIXIL, today's agreement enables us to reduce our risk exposure in non-core areas of operation and represents a new chapter in our transformation as we focus on strengthening our water and housing technology businesses and seek to invest more resources in these high growth areas."

The transaction is in line with LIXIL Group's ongoing efforts to simplify its business structure and focus on its core businesses, enabling further synergies and efficiencies through enhanced integration. As Permasteelisa's operations are significantly different to those of LIXIL Group's core business operations in terms of business cycles and other factors, the sale will also enable LIXIL Group to simplify and eliminate ongoing exposure to different types of risks. This transaction is also expected to strengthen the company's balance sheet as well as financial strength by generating cash, reducing debt, and improving working capital efficiency, enabling LIXIL Group to further invest in new and profitable growth areas across its core businesses as it strives to make better homes a reality for everyone, everywhere.

"We are excited to have reached an agreement to acquire Permasteelisa, as we believe the company has a solid foundation in place for success, particularly as a focused, stand-alone business that is well capitalized," said Timothy J. Fazio, Co-Founder and Managing Partner of Atlas. "The company has a strong management team led by Klaus Lother, and a skilled workforce. When coupled with our expertise in the building materials and commercial construction markets and our attention to client satisfaction, innovation and operational improvements, we will build an even stronger company in the months and years ahead."

Permasteelisa Group CEO, Klaus Lother added, "Permasteelisa drives innovation in the curtain wall sector by integrating design, engineering, manufacturing capabili-

➜

ties and project management to achieve works of excellence worldwide. Under LIXIL's guidance and with the consolidation of our leadership role, we were able to respond to significant challenges in an increasingly complex and competitive landscape. We are now entering a new phase of our evolution. We thank LIXIL for its full and constant support and are confident that with the ownership and support of Atlas Holdings, we will continue our evolution whilst generating value within the construction sector."

While details of accounting treatments and presentation methods are now under discussion with the auditor, in line with International Financial Reporting Standards ("IFRS"), Permasteelisa will be classified as discontinued operations in LIXIL Group's financial reports. In addition, contingent liability is expected to decrease by approximately JPY 150 billion, which is expected to have a positive impact on fund raising

costs, etc. As a result of this transaction and other factors, LIXIL Group today also announced a revision to its full year financial forecast. Full details can be found in the timely disclosure, "Announcement Regarding Revision of the Forecast of Business Performance For the Fiscal Year Ended March 2020 (Consolidation) and Recording of Extraordinary Loss from a Subsidiary in Japan."

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MIR STEKLA

Rescheduled to 2021

Mir Stekla will not take place as scheduled on 8–11 June 2020, and has been rescheduled to 7–10 June 2021. This decision has been taken due to the ongoing COVID-19 pandemic and recommendations of Rospotrebnadzor (the Russian Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing) and the Moscow City Government. The organizers' main objective is the safety of exhibitors and visitors and they felt to have no other choice than rescheduling the fair to next year.

For more than 20 years Mir Stekla has been maintaining its position as the largest industry platform in Russia and Eastern Europe, it revives the best traditions of glass production, promotes new technologies, advanced equipment and tools for glass manufacturing and processing on the Russian market.

The participation in the Mir Stekla exhibition gives the opportunity to learn about market novelties and world trends, establish new business contacts, find suppliers and increase sales.

The latest technologies of glass manufacturing, modern machines, equipment and tools for the production of a wide range of glass products for construction, furniture, automotive, medical, chemical, food and other industries are on show on an area of more than 11,000 sq.m.

Specialists get acquainted with software for glass producers and processors, architects, designers, contractors. Research institutes, training centres will showcase their innovative developments.

The ArtGlass Salon demonstrates original artistic and design solutions and interior items. Within the salon there will be master classes on manufacturing of art products by artists-glass blowers.

WWW.MIRSTEKLA-EXPO.RU

HORN

Progress on expansion of new building wing at headquarters

At the moment, the workers are smoothly plastering the inside and outside of the masonry and completing the electrical installation. The latter is a novelty at **HORN** as all components in the building will have a digital accessibility. Whether lighting, heating, blinds, locking and alarm systems, everything can be controlled digitally. Even subsequent conversions within the building are easily possible. Another important fact: the system is not cooled by air conditioning, but by component activation. Pre-installed pipes with cold water cool the rooms without draught or noise. The integrated ventilation system ensures a pleasant room climate thanks to constant but unobtrusive air circulation.

60 employees will find a new vocational home in the complex. Smaller office units, fitted for 2-3 people, instead of open-plan offices enable the teams to create an inspiring and productive working atmosphere. The project is scheduled to be finished by mid of 2020.

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SCHOTT

Xensation® Flex – the foldable glass revolution

SCHOTT, the inventor of speciality glass, is pushing the boundaries of human imagination with its flexible glass line-up. The international technology group now introduces Xensation® Flex, the most flexible ultra-thin glass that is available in mass production. The new flexible cover glass product line-up offers breathtaking bending radii below 2mm after processing and is an addition to the company's Xensation® high-performance glass portfolio.

Before there were smartphones, there were flip phones, a legendary design concept that made the cell phone a must have device. Now, Samsung's impressive Galaxy Z Flip has brought flexible displays to the smartphone universe, successfully revitalizing the flip phone concept for the mobile era. As premium phone makers are constantly searching for the best components – including display materials – a flexible glass offers outstanding characteristics in regards to a premium appeal.

Dr. Feng He, Head of Global Product Mgmt. and Application of SCHOTT UTG Product, said, "We are supplying ultra-thin glass to Samsung now. This means our technology and high-volume production capability are in a leading position versus other glass players. We continue to improve and strengthen our ultra-thin glass offering with the official market launch of the Xensation® Flex brand."

With Xensation® Flex, SCHOTT is now introducing the most flexible ultra-thin glass that offers high transparency and the ability to be chemically toughened. SCHOTT sustainably produces high quality glass in Germany and then shipped to processors for further processing.

Xensation® Flex offers UTG in thicknesses less than a human hair. After processing, its bending radius below 2mm makes it suitable for applications in foldable displays and paves the way for unprecedented device designs – e.g. foldable smartphones, laptops, tablets or completely new product groups.

Xensation® Flex is based on experience of more than 30 years in researching and producing a wide variety of UTG, tailor-made for several applications. SCHOTT has refined the core UTG production process known as "down draw technology". During the down-draw process, a glass ribbon is pulled down from the top, moving across various rollers and through the cooling track. Thanks to this eco-friendly technique, glass of desired thinness is directly drawn from the melt to achieve stable thinness – with no further harmful acid etching needed.

Xensation® is SCHOTT's response to an ever-demanding consumer electronics industry. Initially invented as a rigid, high-performance cover glass, Xensation® Flex now proves that strength can also come with the ability to bend. The broad portfolio enables designs that have never been possible before or offer industry-leading features in set drop performance or strength.

Xensation® Up. – SCHOTT's high-performance cover glass for rigid-display solutions – provides outstanding resistance against breakage, especially with regard to set drop performance. The lithium aluminosilicate (LAS) cover glass is built on a heritage of more than 130 years: SCHOTT was the first com-

➜

pany to use LAS as a protective cover glass. The founder of SCHOTT, Otto Schott, was the first to document the addition of lithium to a glass mixture as part of his wide-ranging experiments that eventually led to the invention of speciality glass. LAS now provides improved strength, flexibility, and reliability for global partners.

Xensation® Up. has enabled new designs and innovations from clients, including leading smartphone manufacturers from China vivo and OPPO. vivo recently launched a series of smartphones, including NEX 3s 5G phone with a curved waterfall display, iQOO 3 5G phone, and brand new design piece X30 Pro with Alexander Wang edition and rainbow edition. OPPO just launched OPPO Smart Watch in March, 2020 with a 3D curved screen design. All of these concepts underline the market-leading capabilities of Xensation® Up. high-performance cover glass.

With deep knowledge in the smartphone market accumulated since the launch of the 1st generation in 2011, SCHOTT Xensation® is pushing the boundaries of display innovations. With Xensation® 3D, SCHOTT was the first cover glass maker worldwide to develop a protective smartphone cover based on aluminosilicate with the addition of lithium. Now with Xensation® Up. of enhanced strength and Xensation® Flex for foldable displays, SCHOTT Xensation® provides specialty glass solutions to all available display technologies with mass production capacity. With raw glass production in Germany, Xensation® is now supplying global consumer electronics markets.

WWW.US.SCHOTT.COM

KERAGLASS

Successful installation of HST at Batalha Tempra

Keraglass has announced the successful installation of a Heat Soak test furnace for large sheets of glass at **Batalha Tempra**, Leiria, Portugal. The Heat Soak test, so-called HST, is carried out on tempered glass with the aim of reducing to a minimum the risk of spontaneous breakage of the glass sheet.

The test allows to certify the tempered glass in compliance with the UNI EN 14179 standard and significantly eliminate the possibility of sheet failure, which would break in place due to the presence of nickel sulphide (NiS) created by sulphur and nickel particles, which inevitably end up in the glass mass during production in the blast furnace.

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KG keraglass

RESEARCH FRONTIERS

Investments from Hyundai, Blue Red Partners and Avery Dennison

Research Frontiers SPD-SmartGlass Licensee and Strategic Investor *Gauzy Ltd.* has secured the Series C investment from Hyundai Motor Company, Blue Red Partners VC (Singapore), and Avery Dennison, despite the current crisis.

Gauzy has been collaborating with industrial players to integrate Gauzy's LCG® (light control glass) technologies, including SPD (suspended particle device) and LC (Liquid Crystal), into the serial production of various types of products. Both technologies allow for dynamic and user-controlled light control. SPD provides the ultimate light control solution – comfortable, safe, and energy efficient. LC technologies are used for privacy, solar reflection, and displays that turn transparent for smart mobility solutions.

In February 2019, Gauzy announced on NASDAQ a strategic investment in Research Frontiers and its plans to develop and manufacture SPD. Throughout the year, Gauzy established the infrastructure required to create its SPD technology. This includes erecting a state-of-the-art material synthesis facility in Israel, and a custom SPD production line strategically located in Germany (Stuttgart) as part of Gauzy's subsidiary company, Gauzy GmbH. These two facilities are currently operating and producing SPD emulsion and light control film for the automotive, aircraft, and architectural industries, with modified staffing and procedures to protect Gauzy's employees during the COVID-19 pandemic.

In December 2019 Gauzy hosted automotive and tier one executives from around the world at an exclusive event revealing its new proprietary production line set within an 11,000 sq.m. property in Germany. This production site is dedicated to producing 1,000,000 sq.m. of SPD material yearly for the automotive and architectural industries. Gauzy's state-of-the-art production techniques have brought down the cost of SPD-Smart light control technology significantly, has shortened delivery times to customers, and have added new capabilities and functionality to the world of smart glass.

Gauzy is the only material science company in the world currently developing, manufacturing, and marketing two of the three commercial active light control technologies: LC and SPD. The company has a global distribution network of over 60 certified partners worldwide that apply Gauzy's unique technologies to glass or other transparent substrates, to create LCG (light control glass). SPD and LC technologies allow glass to change from opaque to custom degrees of transparent with electrical input to control various forms of light including UV, IR, and visible light. SPD blocks up to 99.5% of light for custom shading while maintaining a view of surroundings. It can be used to replace mechanical shading elements in buildings and vehicles.

Eyal Peso, Gauzy's CEO, said, "We are proud to announce this investment that comes at a hard time and also comes to show the depth of the confidence the investors have in Gauzy and its technologies. We have been working closely with industrial ➜

players over the years to develop for series production, and the investment will help Gauzy step up its efforts in the delivery of its products all over the world."

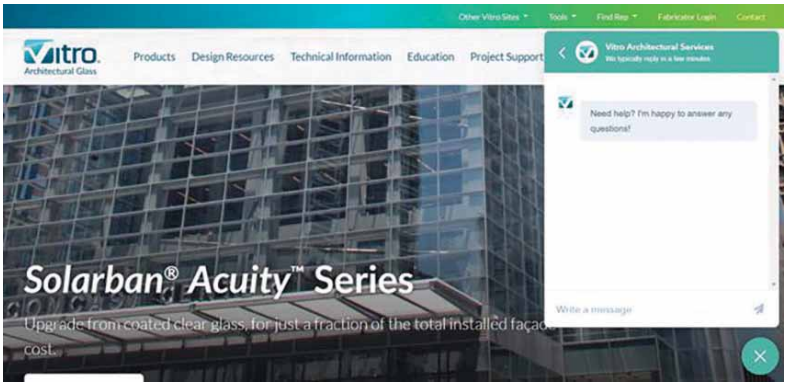
This Series C investment allows Gauzy to continue its mission of developing and leading the active light control technology market. With continued advancement in product development and of resources for high volume production, LCG technology and active glazing is more accessible for serial implementation by industrial players.

Joseph M. Harary, President and CEO of Research Frontiers noted: "This Series C investment round by Gauzy is significant in many respects. This strategic investment marks the first known equity investment by an automotive OEM in our entire industry. While it certainly benefits the investors in Gauzy, and Research Frontiers, it also benefits all of our licensees and their customers in the automotive, aircraft, marine, architectural and consumer products industries worldwide. It is the result of a highly focused and collaborative effort by key companies in the material science, glass, technology and automotive industries."

WWW.GAUZY.COM

VITRO ARCHITECTURAL GLASS

Live chat launched



Vitro Architectural Glass has announced that architects, designers and glazing contractors can now access a new live chat service available at www.vitroglazings.com.

The tool was developed primarily to provide responsive, real-time design support to architects and other design professionals, many of whom may be working from home offices. Emily Losego, architectural services team leader, Vitro Architectural Glass, said the introduction of the live chat service is part of Vitro's ongoing effort to enhance its real-time support services for architects, specifiers and glazing contractors.

Operated by Vitro's Architectural Services team, the live chat service is available 8 a.m. to 5 p.m., Eastern Standard Time, Monday through Friday.

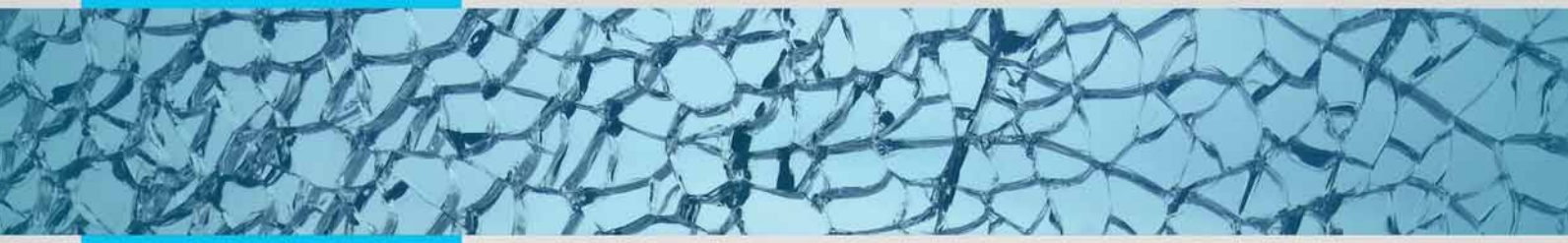
"We've received numerous requests from design professionals for a live chat function over the years," she explained. "Now we have the capability to provide live responses to their questions within minutes, whether they prefer to contact us electronically or reach us by phone. That enables us to help at every stage of the design process, from product evaluation to specification to sample requests."

Since the live chat service debuted on 2 March, architectural service representatives from Vitro Glass have answered questions from addressing available products to selecting the right glass for specific projects. Other topics have included selecting glass tints and spandrel colours, recommended glazings for the clearest glass and advice about fabrication-related issues.

During hours when the live chat service is not available, architects, designers and glazing contractors can contact architectural services representatives through Vitro's web contact form.

WWW.VITROGLAZINGS.COM

GLASSCOMPANY



FLAT AND BENT

FLAT AND BENT GLASS TEMPERING FURNACE

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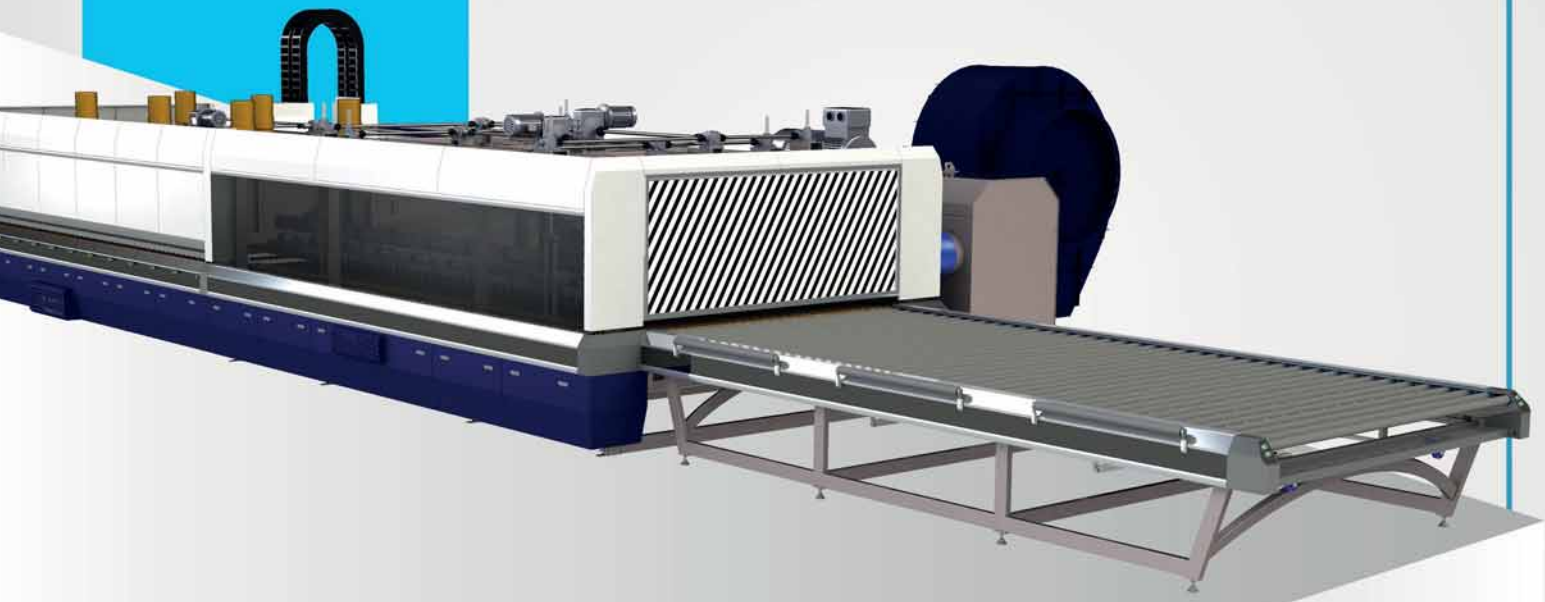


GLASS TEMPERING FURNACE

Crystal Units is a family business that has been active in the glass industry for over 25 years. Thanks to continuous growth over the years, the company now produces about 30 tons of glass products per day. This is also made possible thanks to 20 years of cooperation with LiSEC.

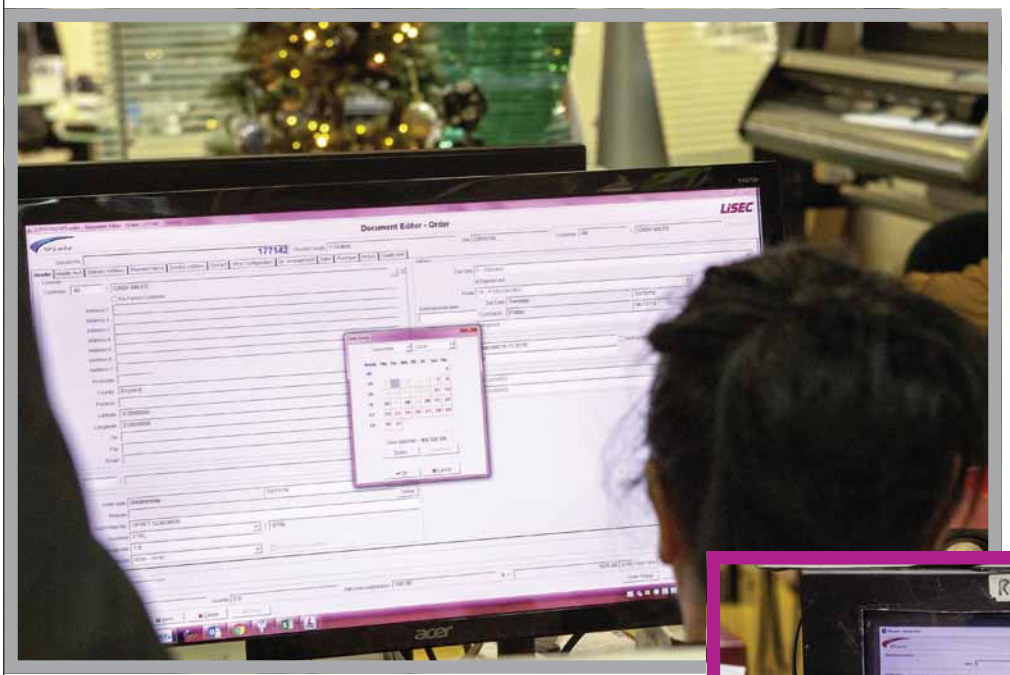
LiSEC

TOP COOPERATION AND TOP SERVICE FOR CRYSTAL UNITS

BROAD PRODUCT RANGE, FLAT HIERARCHIES AND CUSTOMER CONTACT AT EYE LEVEL

Crystal Units was founded in 1994 and currently employs about 100 people. The company has two locations in London, with a total area of approximately 5,000 m2. The company primarily manufactures insulating glass elements. In recent years the company has moved in a new direction, now also offer heated glass, bonding, lamination, etc. Crystal Units can also carry out work such as silicone bonding or toggle systems.

A special highlight in the product portfolio of the English glass processor is CUIN (= ultra-thermally

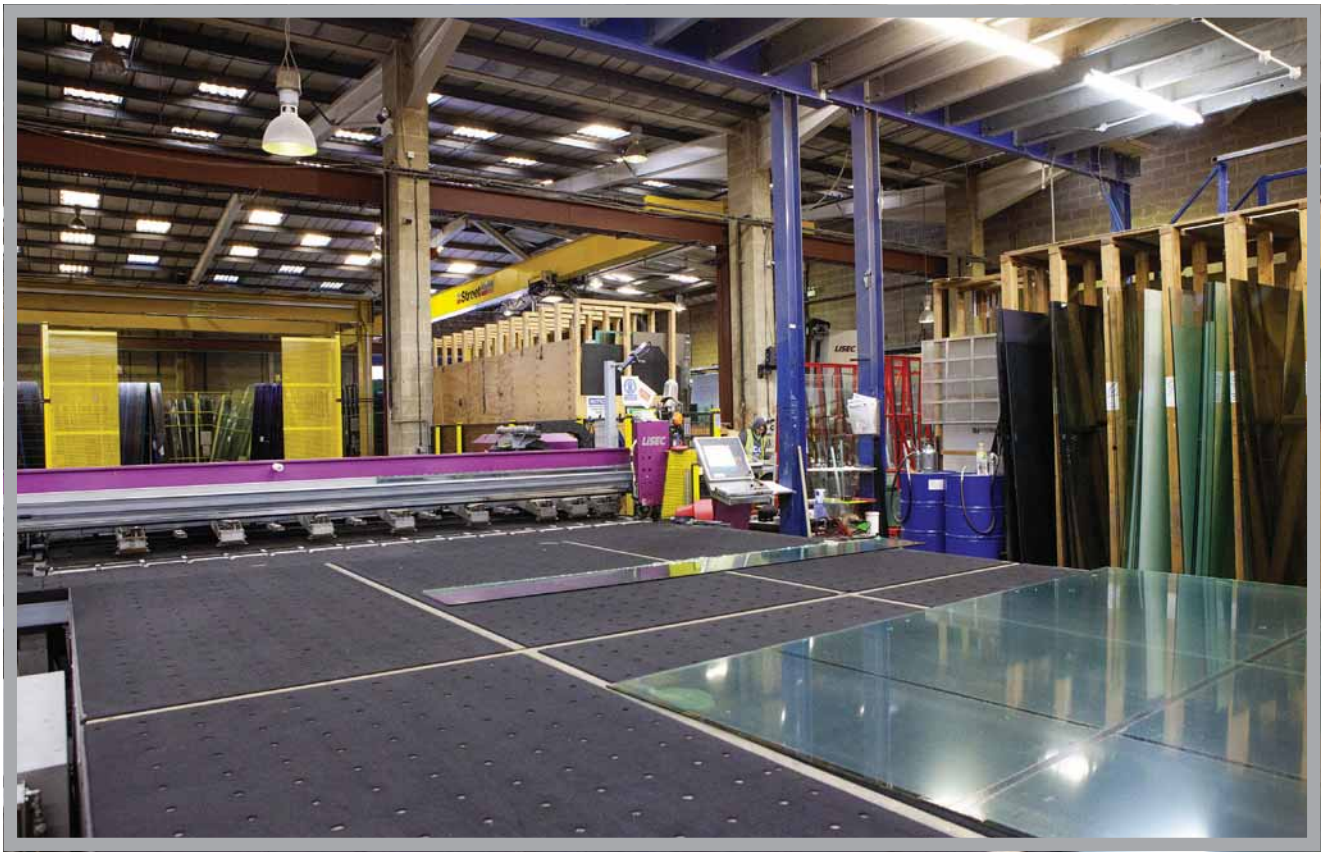


efficient insulating glass). In this product, two panes are used instead of three for triple-glazing and a film is placed in the middle where the third pane would be placed. This leads to higher energy efficiency and lower U-values. As a result, CUIN is more environmentally friendly and performs better than conventional glazing.

The company is characterised by a flat hierarchy. In addition, the doors are always open for its customers. "Our customers can always come by and talk to us personally if they have any problems. We meet them at eye level," state the two managing directors Pankaj Gorsia and Vijay Halai. "We help our customers and guide them through their entire project." The two say that they love to share their expertise and know-how and always make sure they find the right product for their customers "We can help our customers design their optimal product. We have a good team that has built up a lot of experience over the years," says Pankaj Gorsia. The company's good reputation through its customer proximity and product quality brings many advantages in the market and this positive word of mouth is one of the reasons for the organization's steady growth.

'GLASS COMPANY OF THE YEAR'

In 2019, Crystal Units won the G19 award in the 'Glass Company of the Year' category. Vijay Halai



and Pankaj Gorsia are delighted about the award: "We are proud to be Glass Company of the Year 2019. In an increasingly competitive market where market forces such as price erosion and 'value engineering' unfortunately seem to become the norm, Crystal Units has made the strategic decision to be different. By adding value to our products and services, we strive to be the first choice for quality, reliability and responsibility in glass sourcing. With innovation and customer focus at the core of our values, combined with our extensive product range and knowledge base, Crystal Units has become the one-stop shop for all glass needs."

TOP COOPERATION THANKS TO TOP SERVICE

The cooperation between Crystal Units and LiSEC began almost 20 years ago. Vijay Halai and Pankaj Gorsia remember: "We always dreamed of buying a LiSEC machine one day. With the actual investment in the first LiSEC machine, everything changed for us – into the positive." Today, approximately 95 per cent of the machines and software in Crystal Units from LiSEC – from insulating glass lines to cutting tables and loading systems, everything is included. Vijay Halai and Pankaj Gorsia are satisfied: "We have a very good business relationship with LiSEC. The technical support, the service, the feedback loops – we can't complain and are happy about the continuous exchange. Having also gained experience with other machine manufacturers, we can say with reasonable certainty that LiSEC is the right supplier for us, offering us the right machines and the right service, thus the perfect basis for us to run our busi-

ness the way we want and need to."

For Vijay Halai and Pankaj Gorsia, service is the main factor that sets LiSEC apart from the competition: "Anyone can sell, deliver and install a machine. It is the after-sales service that has to be top-notch – that's why LiSEC is the best choice. In the event that we have a problem with a machine at 10 o'clock in the evening, we can rely on the fact that someone from the service team is quickly available to help us quickly and competently. The service we get on the phone from Austria is second to none."

What the two entrepreneurs particularly like about working with LiSEC is the honest communication. "If LiSEC says they're going to do something, they do it." If the company has questions regarding machines, technical options or special functions, it will receive clear answers and no 'maybe'.

Roger Hafenscherer, LiSEC Service Manager, about the joint cooperation: "The cooperation already goes beyond a business relationship. I appreciate the honest exchange about strengths and weaknesses and our friendly relationship that has developed as a result. We are united by the understanding to improve together and to get the best out of the machines." In this way, both sides look positively into a common future.

LISEC

LiSEC, with headquarters in Hausmening/Amstetten, is a globally operating group, and has been offering individual and complete solutions in the field of flat glass processing and finishing for over 50 years. The service portfolio includes machines, automation solutions and services. In 2018, the group, with around 1,300 employees and over 25 locations, generated total revenues of around EUR 230 million, with an export rate of more than 95 per cent. LiSEC develops and fabricates glass cutting and sorting systems, single components and complete production lines for insulating glass and laminated glass fabrication as well as glass edge processing machines and tempering machinery. With reliable technology and intelligent automation solutions, LiSEC sets standards in quality and engineering and significantly contributes to the success of its customers.

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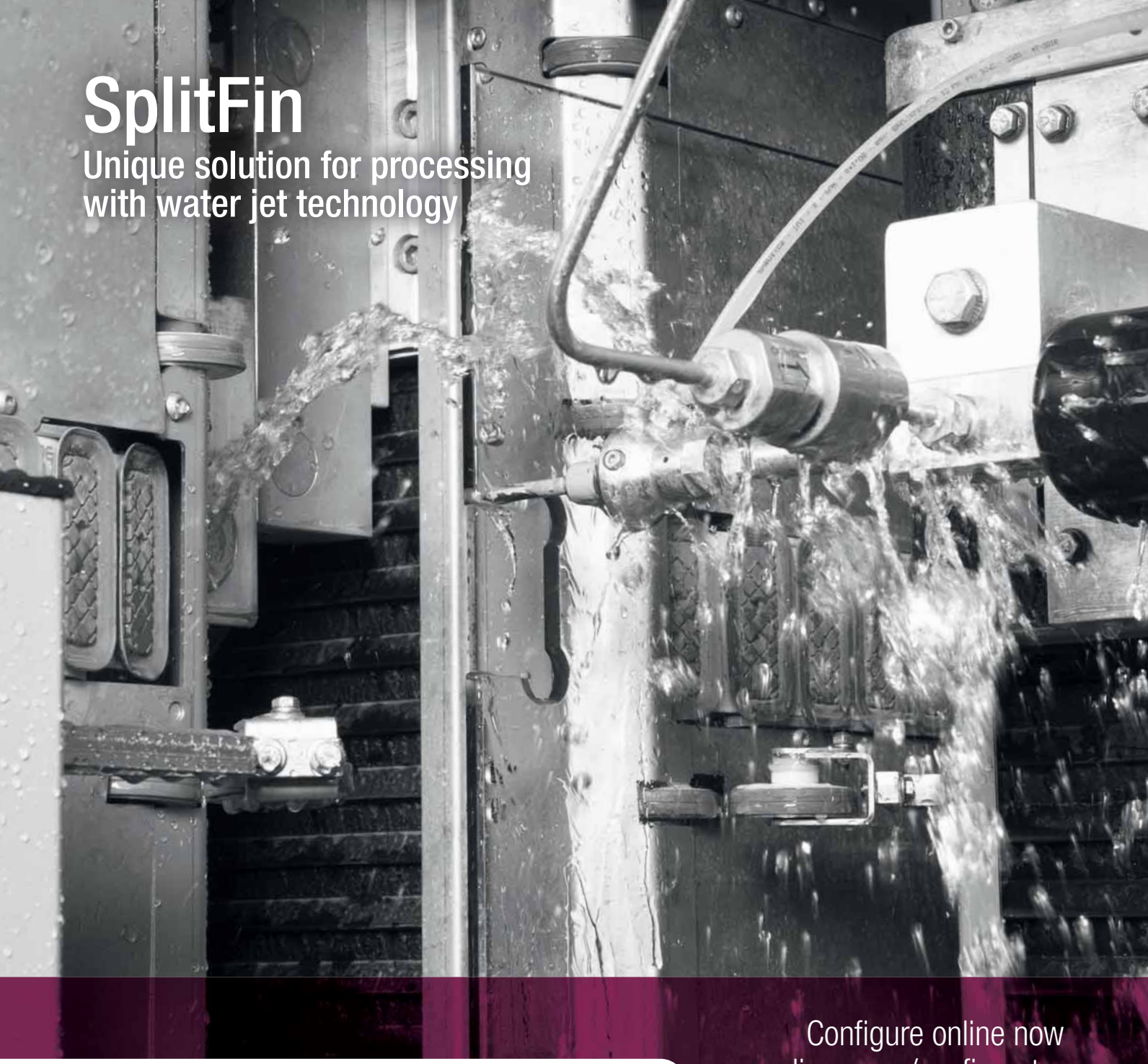

SplitFin

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The SplitFin is an integrated and continuous solution for fast, effective and uncomplicated processing of glass sheets. The line is aimed especially at the complete processing of sheets. A significantly higher output is achieved in comparison with individual machines as a result of the distribution of the processing steps (edge polishing and grinding / drilling and milling with water jet / washing & drying) and the associated permanent use of the individual devices. The SplitFin sets new standards, not only through extremely fast cycle times, unparalleled in the industry, but also with regard to ease of maintenance as all of the most important mechanical assemblies are easily accessible and in the dry area as far as possible.

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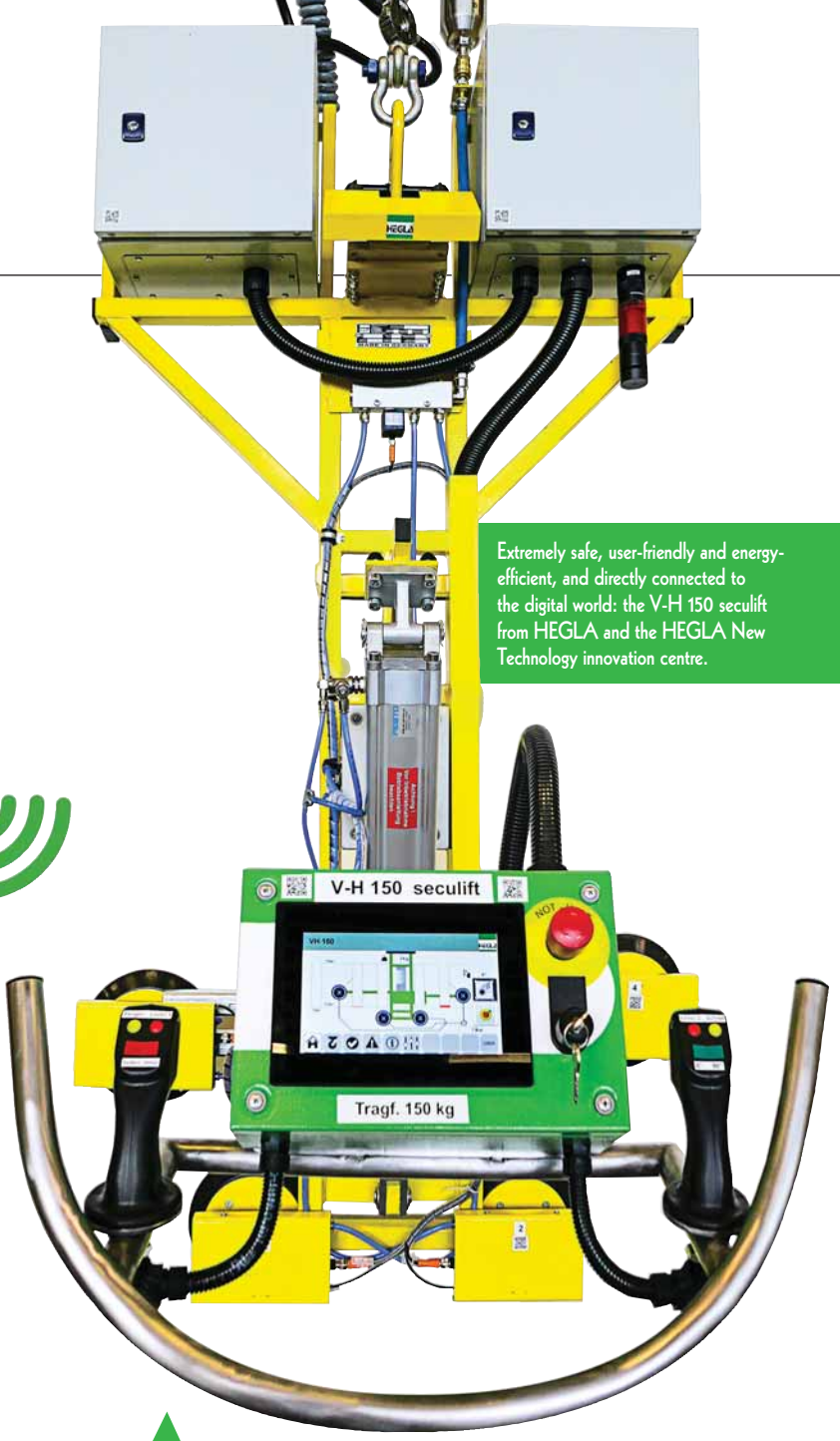
LiSEC

best in glass processing

When presenting new generations of well-known products, machinery manufacturers need to consider a whole range of features and needs that glassmakers, processors and glaziers have. With the new V-H 150 seculift, HEGLA has not only expanded functionality, but also offers an even higher degree of safety for day-to-day work, with IoT networking to provide continuous updated information.



Extremely safe, user-friendly and energy-efficient, and directly connected to the digital world: the V-H 150 seculift from HEGLA and the HEGLA New Technology innovation centre.

HEGLA

V-H 150 SECULIFT WITH SAFETY CHECK FUNCTION FOR SMART, SAFE GLASS HANDLING

With the new V-H 150 seculift, HEGLA and the HEGLA New Technology innovation centre present a new generation of the V-H suction device for lifting, setting down and manipulating glass. A user-friendly and intuitive control concept, energy-saving vacuum generation and the IoT networking option are not only intended to expand the range of functions available for vertical-horizontal glass handling. The lifting device also offers an even higher degree of safety for day-to-day work on cutting systems, furnaces, and laminating lines.

ADVANCED SAFETY AND FUNCTIONALITY

"When it came to developing the V-H 150 seculift, we took a look at the glass handling process as a whole and completely rethought it," said HEGLA Managing Director Bernhard Hötger. "We paid particular attention to providing maximum safety alongside excellent ease of use, minimal compressed air consumption, and integration into the digital world."

STRICT SAFETY STANDARDS

The strictest customers' safety standards have been integrated into the design of the V-H 150 seculift. In practical terms, this means that the entire work cycle is continuously monitored by the built-in safety controller – from lifting, moving, and tilting to setting down the glass. The monitoring begins when suction is applied to pick up the glass: if one of the suction cups is unable to generate a vacuum, it is automatically disabled. The weight of the glass element is measured as soon as it is lifted. If it exceeds the permissible weight for the number of suction cups active at the time, movement stops immediately and the operator receives an unmistakable visual and acoustic warning. In such cases, the glass element can still be set down. Another potential danger is the risk of the glass element getting blown off during transport, causing it to come loose and fall to the ground. To prevent this, the blow-off system is disabled during transport, and two hands are required to operate it when setting the glass down.

SAFETY CHECK FUNCTION: REGULAR FUNCTIONAL TEST

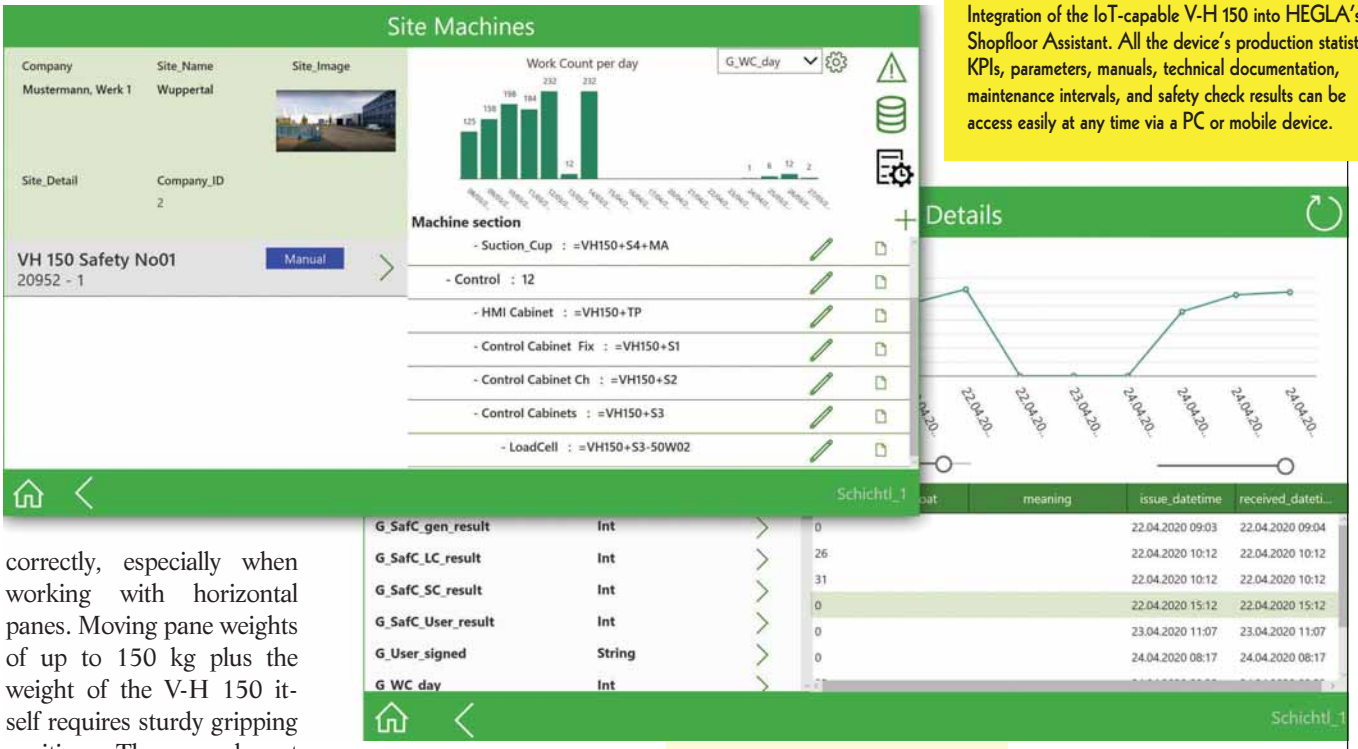
In order to guarantee maximum safety at the workplace, the device prompts the operator to carry out a complete functional test for one work cycle every eight hours, or at a custom-defined interval. This functional test is performed using a dedicated user interface. The operator receives prompts to initiate each step, and each step can be seen on the screen upon completion. If the test is completed successfully, a countdown to the next test begins. Otherwise, or if the device fails the test, the device is locked to prevent normal operation

USER-FRIENDLINESS

In order to make working with the V-H 150 seculift as convenient as possible, considerations such as a clear view of the glass element, good, sturdy gripping positions, and ease of use have all been factored into the design. All unnecessary parts have been removed from the operator's field of vision so operators have a good view of the work area.

An optional marker laser is available to assist with orientation and make it easier to ensure that the glass is lifted

The strictest of our customers' safety standards have been integrated into the design of the V-H 150 seculift. In practical terms, this means that the entire work cycle is continuously monitored by the built-in safety controller – from lifting, moving, and tilting to setting down the glass.



Integration of the IoT-capable V-H 150 into HEGLA's Shopfloor Assistant. All the device's production statistics, KPIs, parameters, manuals, technical documentation, maintenance intervals, and safety check results can be access easily at any time via a PC or mobile device.

correctly, especially when working with horizontal panes. Moving pane weights of up to 150 kg plus the weight of the V-H 150 itself requires sturdy gripping positions. These can be set using ergonomic joysticks, which are located at a comfortable distance from the operator. All the functions required for the work process (suction pick-up, lifting/lowering, tilting, blow-off) can be implemented directly using the joystick. This ensures that the glass is gripped securely and can be controlled throughout the entire work process. The intuitive graphic display provides important information such as which suction cups are active, the current supply pressure, the weight of the glass, and alarms.

COMPRESSED AIR OPTIMISATION

Conventional suction devices usually possess vacuum valves that work continuously throughout the movement cycle, consuming compressed air and generating noise the entire time. The V-H 150 is more modern: its valves shut off automatically when the required vacuum level is reached. This saves more than 75 per cent on compressed air under normal operating conditions and allowing for noiseless movement to make for a more pleasant work environment.

KEEP TRACK OF WHAT THE V-H 150 IS DOING

We usually know very little about the technical condition of conventional lifting devices, their use history, and their daily routines because they are designed as stand-alone units. The V-H 150 seculift breaks this tradition: it wants to communicate. Thanks to the IoT networking option, the V-H150 seculift can supply company networks with information such as its current condition, daily load cycles (number of glass elements manipulated), alarms, and the results of the safety check. This makes the V-H 150 a smart IoT device.

INFORMATION ON THE GO WITH THE SHOPFLOOR ASSISTANT APP

HEGLA's special Shopfloor Assistant app is a mobile solution that allows to view the V-H 150's information at any time, any place. The app also contains all the required training and maintenance documentation. Simply clicking on the V-H 150 in the app or scan its QR code with a tablet provides all the data and documents on the screen. The app can also be used to document entire machine fleets in the same way and easily integrate information from any machine.

"Here at HEGLA, we're very proud of this development," said Bernhard Hötger. "The ideas built into this device will influence our entire product portfolio as it continues to evolve. This innovative new development represents another step forward in the digitalisation of glass factories – and it's all been made possible by the great minds of Dr. Markus Schoisswohl and his team at HEGLA New Technology, a think-tank in the heart of Paderborn, Germany."

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ITALCARRELLI®

STRENGTHENS ITS AFTER-SALES SERVICE NETWORK – GLOBALLY

Being a global leader in your sector – for ITALCARRELLI® this means special machines and solutions for the storage and handling of goods – does not only involve supplying your machines, but also to give your clients top-level service in terms of assistance. In this article, the company provides our readers with an update on its recent developments on assistance, which also include special software, providing predictive maintenance planning.

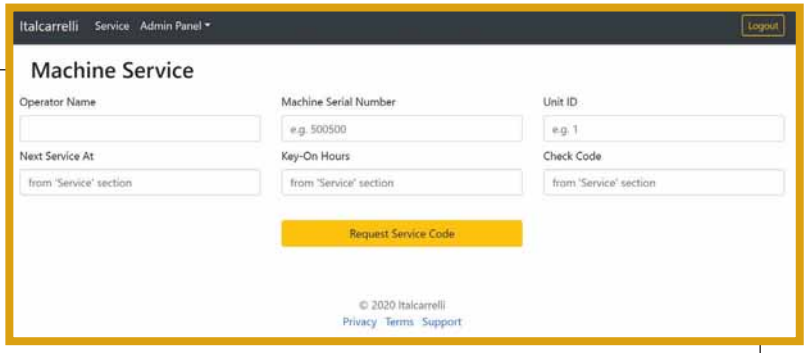
ITALCARRELLI® designs and builds speciality machines and equipment for the storage and handling of goods. The company boasts a worldwide presence with machines delivered in more than 50 countries and an export turnover of more than 95 per cent, working in multiple industrial sectors such as metallurgy, aerospace, special transports, shipyard and others, in addition to glass.

Italcarrelli is the undisputed leader for the supply of machines for glass handling, which are used by production and transformation lines right up to the warehouse and shipment. The company provides its machines to all the world's leading float glass manufacturers, supporting hundreds of plants worldwide.

Glass production plants are continuous cycle facilities that require highly efficient and reliable machinery. To achieve high quality and performance standards, Italcarrelli clients can count on an effective preventive maintenance service – to identify and solve malfunctions that may cause the machine to stop – along with a prompt technical and spare parts supply.

ASSISTANCE – WITH INTERNATIONAL PRESENCE

The company has always invested highly in its assistance service, intervening directly on site with its trained technicians and branches all over the world. To be closer to its customers and to increase its support service, Italcarrelli has expanded in Europe and beyond: a strong European presence with service centres located in Northern Europe – Belgium and France, and Eastern



Europe – Poland and the Czech Republic, and Turkey. In addition, a US office has recently opened for the North American market, and new branches will soon be operational in Brazil and Russia.

Thus, clients receive support from local Italcarrelli technicians: qualified personnel trained directly from the headquarters, speaking the clients' language, already on site and supplied with a stock of original spare parts.

"The decision to expand into Europe and beyond was the next logical step after consolidating our presence in certain markets. In this way we can offer a service that aims to improve more and more, combined with the experience of our team, the resolution of possible snags and the creation of relationships with the local businesses to make them feel that they have chosen the best partner for handling operations," said Italcarrelli Sales Manager, Davide Schiavon.

Strong customer assistance has also resulted in the creation of additional remote systems and services to ensure constant operational safety, detect regular check-ups to be carried out, or maintenance.

The Remote Assistance Unit is a service thanks to which the company's technicians can be connected with any machine at any time and perform check-ups, debugs, modify parameters, update the software and so on.

Moreover, the Italcarrelli Software Department has designed an application that allows to constantly monitoring the status of each machine in order to perform service or other maintenance.

AFTER SALE SERVICE MANAGEMENT SOFTWARE

Last but not least, the company has created an after sale service management software that allows both Italcarrelli operators and clients to have a record of all the interventions and maintenance that have been carried out in the past, on each and every vehicle.

This remote maintenance system ensures predictive maintenance planning customised for each client's fleet, minimising future repairs, for excellent efficiency and performance of the equipment.

Italcarrelli after-sales support network allows being even timelier in assistance, ensuring a substantial local presence focused on operational support and on-site services in all the main international markets and clients based there. The company deals with all the maintenance planning and necessary interventions and offers a wide range of solutions such as full-service contracts, allowing its customers to concentrate on their main activity with the assurance that a qualified team is handling their fleet.

Maintenance, original spare parts, security checks and much more, Italcarrelli is close to its customers with a tailored support service, solid service network and expert technicians.

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Mappi

CONSOLIDATES ITS PRIMARY POSITION IN EUROPE WITH TWO IMPORTANT EXAMPLES - SEMCO GLASS E FORMATOR GLASS

MAPPI AND FORMATOR, A PARTNERSHIP FOUNDED UNDER THE SIGN OF EXCELLENCE

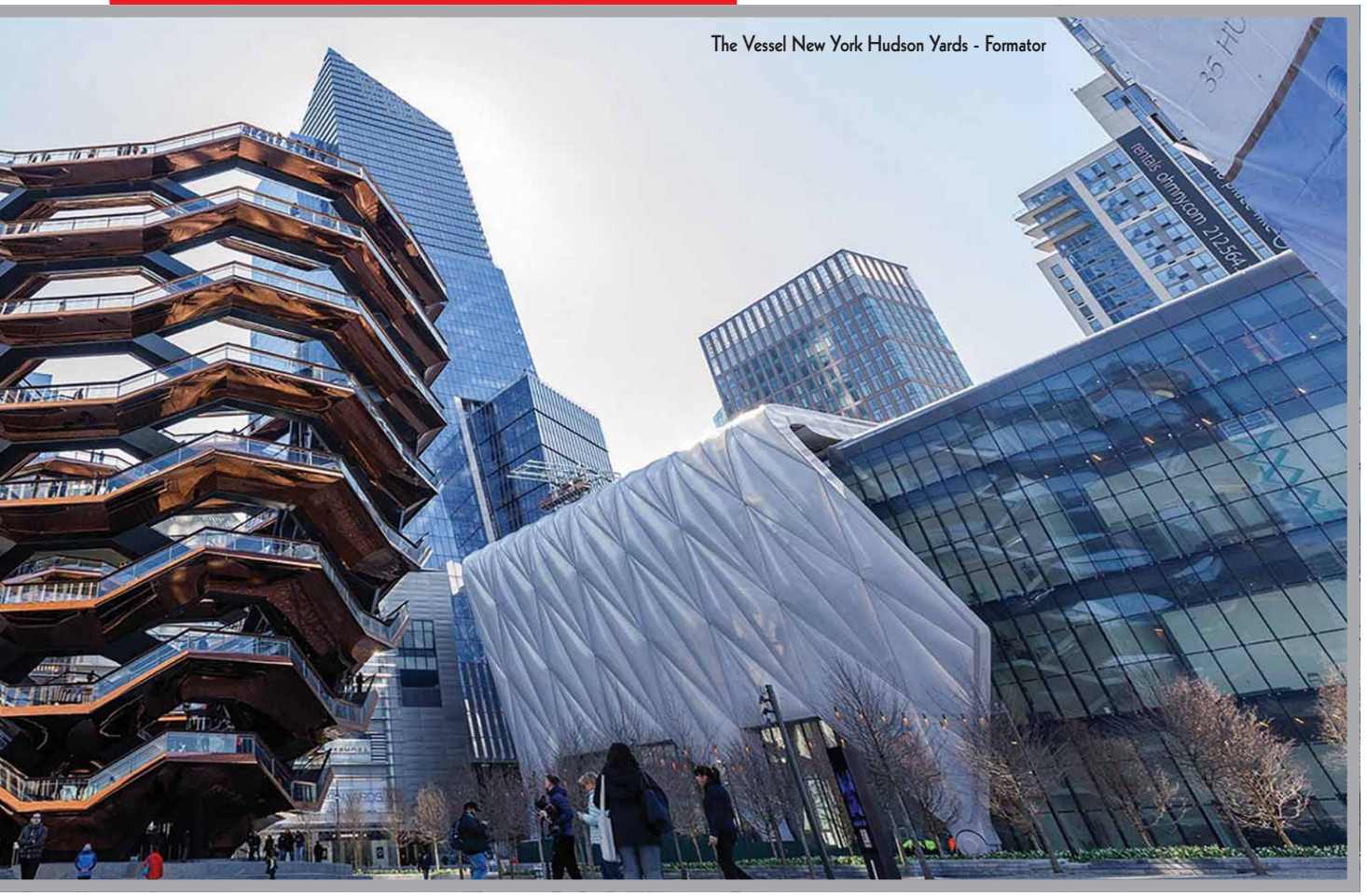
The name Formator derives from a Latin word, which means 'he who creates, he who invents', and Formator was founded for the production and processing of special glasses. The company's immediate goal was to produce in order to export towards international markets and to focus on high-end projects. These special glass types include laminated glass, particular shaped glass, screen printed glass, heated glass, thermochromic glass, glass with PDLC film and much more. The marine sector accounts 40 per cent of Formator's turnover, while the remaining 60 per cent is given by construction projects, especially high-end construction, with high-performance glass and smart functions. One of the latest and most important creations that makes use of Formator glass is the New York Ves-

Speaking to clients is an essential way of finding out exactly what they want from their machinery. And being a machinery manufacturer like Mappi means being able to exploit this information and use it to create machines that respond to demands from clients and from our environment.

sel, an iconic building that has already become a tourist attraction, which equally follows well-known and important buildings such as the London Shard, 310 meters high and one of the tallest skyscrapers in Europe, but also the Doha Airport in Qatar and the Tour Odeon in Monte Carlo.

These are not of course random results, but the result of attention in research and innovation, attention to an increasingly demanding type of customer, who is not satisfied with compliance with standards, but also demands visual and aesthetic perfection.

Perfection is not obtained randomly, but achieved by choosing absolute quality partners and collaborators. Moreover, as the tempering furnace is the centre of the entire production chain in glassworks, when Formator had to choose how to replace its first tempering furnace with something that was able to meet the standards of the present and the future, it began a strict and meticulous search that took several months.



The Vessel New York Hudson Yards - Formator

Let's hear how this research was carried out and to what results it brought, from the voice of Robert Miklus, owner of Formator.

Robert Miklus, Formator: "We made specific and very demanding requests, because we wanted a furnace that was able to satisfy the most demanding customers, not only today, but also for the next 10 years to come. And with this in mind, at the end we chose a Mappi ATS 4.0 furnace. We chose them because they were the only ones who, besides respecting our requests in terms of technical performance, also guaranteed these specifics in writing. Today, after six months using this furnace, we can say that the machine not only meets the performance standards we wanted, but also goes far beyond our wildest expectations."

"This is also valid when we speak about the quality of the glass, which has no defects even in case of square formats or irregular shapes, traditionally the most difficult; thanks to the ability to manage very thin sheets. This has, for us, opened up important new market opportunities, as well as minimizing and almost completely cancelling, the defects of the glass. And with regards to productivity, definitely higher than our previous furnace; also for energy saving, because this furnace, despite being 30 per cent larger than the

previous one and with convection, has lower energy consumption."

It seems a flattering review, especially considering that it comes from those who should offer the market not glass, but special glass of the highest quality. Is there anything that could be improved?

Robert Miklus, Formator: "Honestly not. I don't want to omit some aspects that, even if they do not directly concern the machine, are equally important. The furnace was assembled in record time, on 7 August 2019, the first container arrived with part of the components and on 7 September - after only one month - hardened glass was already being produced. Amazing! Equally amazing was the technical support, the assistance regarding the solution of every slightest mishap, but above all helping us make the most out of the potential of this machine. We are perfectionists and maybe in a few months we will raise the bar even more, but today we have nothing to say: Mappi has left us speechless."

SEMCO: WITH MAPPI FURNACES "FLATNESS AND SURFACE QUALITY ARE VERY MUCH IMPROVED AGAINST OUR OTHER TOUGHENING MACHINES"

Semco was founded in 1997 with the fusion of Schüller Qualitätsglas and Isoglas Nordhorn. Today it has 1,500 employees at 18 locations, with turnover of around EUR 217 million. The company covers a large range of products, from basic glass to safety glass, from functional glass to curved glass, and is a leader in Germany's glass market, strengthening this position through an intelligent and constant investment plan.

In the last 10 years, the owners have invested over EUR 150 million. An important part of this is Made in Italy, Made in Mappi: tempering furnaces for flat glass which are universally

recognized as being among the best for ease of use, quality of tempering, energy consumption.
Let's hear the feedback from Semco about their new Mappi furnaces.

Semco: "We are very pleased with these tempering machines. We are achieve results that enable us to raise the performance of our toughening plants to a higher level."
Semco has chosen a Mappi tempering furnace for the Nordhorn plant. It is a Jumbo Series furnace, capable of handling large glass sheets.

Which are the main strengths Semco has encountered in Mappi tempering furnace? Is it the quality of tempered glass, or reduced energy consumption, ease of use, simplicity in maintenance, or something else?
Semco: "These plants have a number of important features. The quality of tempered glass from our Mappi toughening machines, with respect to flatness and surface quality, is very much improved compared to our other toughening machines. We monitor energy consumption carefully, and have verified the energy consumption ratings given by Mappi."

Sounds really good. Any other plus?
Semco: "A big bonus is that Mappi toughening machines can be switched off when not being used, further helping us with energy savings. On the Mappi ATS 4.0, maintenance is aided by the possibility of removing the lower part of the furnace sideways. This allows for easy access to heaters, protective grids and thermocouples, and enables fast inspection on the insides of the furnace in general."

When switching to a new type of machinery, adaptation problems may occur. How was this situation with Mappi?
Semco: "The user interface provides very good control over all features of the toughening machine. Simple glass pieces and layouts can be carried out by processing according to a recipe system, where – when processing more complex pieces – an experienced operator can easily optimise all parameters on the fly.
Finally, we were very happy with the installation of the toughening machines at our site. Mappi's engineers did an excellent job during installation, commissioning and training, and completed all installations well on time. We certified these machines though an external auditor, and passed certifications without issues."

Your company is very focused on the quality of life of the people who work with you. One of the aspects we take more care of is making Mappi furnaces 'user friendly'. Have you verified this quality in your experience?

Semco: "We have certainly verified this from three perspectives:

1. Operator/user interface and training was carried out by very experienced and qualified staff, with a flexible approach. If, for example, translations were required to match specific expressions closer to our understanding of the process, these were implemented the same day. This, in particular, enabled us to implement a toughening plant at a site that had no toughening experience, allowing the site to run this machine on its own within a matter of only a few weeks.
2. Maintenance – the plant layout is optimised to provide easy access to all parts requiring regular maintenance. Labelling guides our staff to find the parts for service very quickly.
3. Operation – the recipe system allows for easy operation of standard glass pieces by our operators. For more complex workpieces, e.g. with large cutouts and screen-prints, our experienced operators can easily modify all relevant parameters in the user interface to provide best quality glass.

Semco stands out for continuous innovation, what do you think of the fact that, first in the glass industry, Mappi tempering furnaces are 'powered by Siemens' and can dialogue with the entire production structure through Mindsphere?

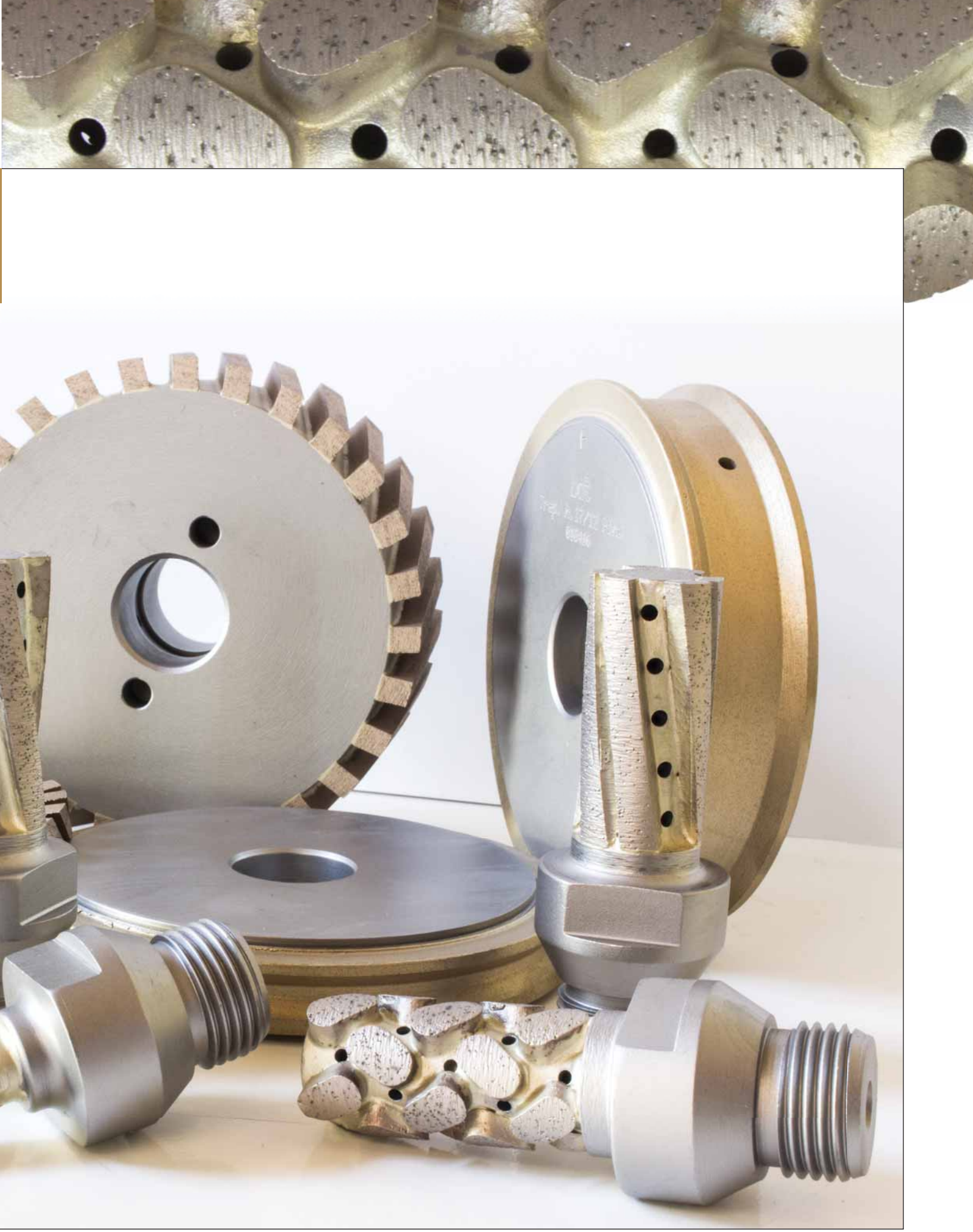
Semco: "Semco actively implements innovative production concepts over a wide range of different machines. We are very positive towards data structures that allow us to analyse our processes in depth. In particular, we gain from optimised throughput and predictive maintenance.
In our view, improvements in information data structures will allow us to bring our experts even closer to our processes, and enable us to optimise these in detail. Our challenge now is to integrate our operators into this process, so that we can use such benefits all together. This will accelerate Semco move forward even further, both technically as well as economically."

Bovone Diamond Tools

NEW DEVELOPMENTS IN GRINDING AND MILLING EQUIPMENT

Focussed on glass processing equipment – and in edge finishing first and foremost – is what the company in this article does. Bovone Diamond Tools (BDT) gives us an overview on its most recent product developments, with a special focus on Goldnet.

Bovone Diamond Tools has always considered the production of cup wheels for bevellers and grinders as its flagship product for the glass processing sector. In fact, the company has always focussed on the production of cup wheels for the most important Italian and international machinery manufacturers, providing a wide range of products in terms of size, hardness and height of the diamond band, as well as – of course – the possibil-



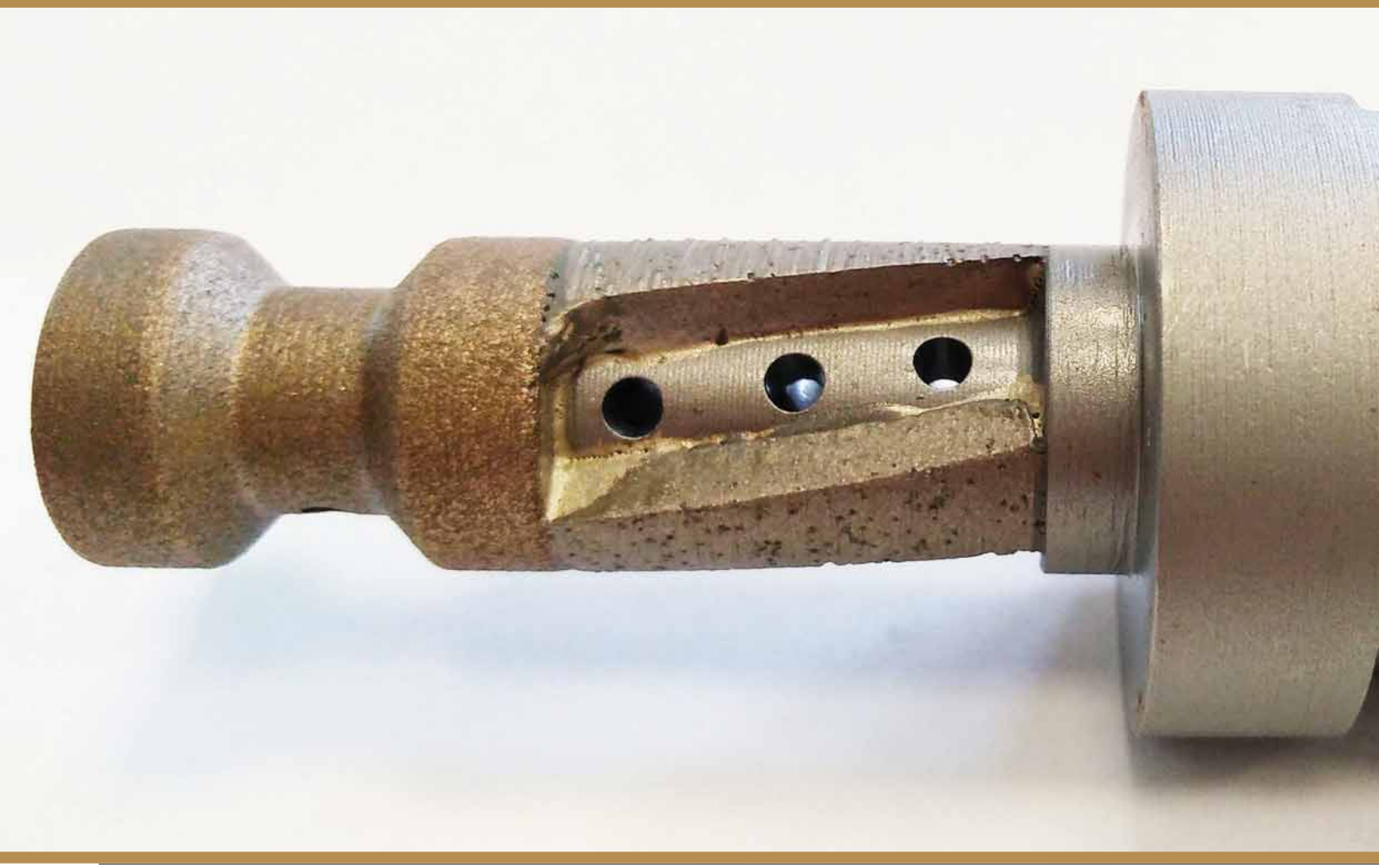
ity of customisation of the tools.

INVESTMENTS AND DEVELOPING NEW PRODUCTS

Continuing with its company reorganisation, BDT is exploring and developing new products, to give both consolidated and new clients an important series of advantages thanks to the well-known distinctive values.
The company is also continuing to invest in the commercial development of peripheral grinding wheels for numerically controlled machines, compatible with the work centres of all the best-known manufacturers: this business area has grown increasingly and, today, represents an important part of the entire production.

ROUTERS - GOLDNET

This product sector includes routers, with 3,4,5 and 6 sectors in different diameters and lengths, and Goldnet, a leading product for the processing of laminated glass with a high percentage of PVB or EVA.
Goldnet guarantees lower production of chips and breakages in output, homogeneous wear, silence, absence of vibrations, high cutting power and considerable durability. Unlike traditional routers, Goldnet has much smaller ogival shaped diamond sectors, which are welded to form a 'mesh' by means of crossed links.
This shape enables to increase the cutting speed of the laminated glass, while avoiding the recurring problem of breakage of the glass edges when the router exits. This is made possible as the PVB is cut continuously and is released from the numerous grooves of the Goldnet router, thus avoiding the formation of the classic strip that is created using traditional cutters.
All BDT routers – including Goldnet – are available with both standard and Forvet connections available in sector-, trapezoidal- or groove versions, obviously in different diameters.



Combi – two-in-one

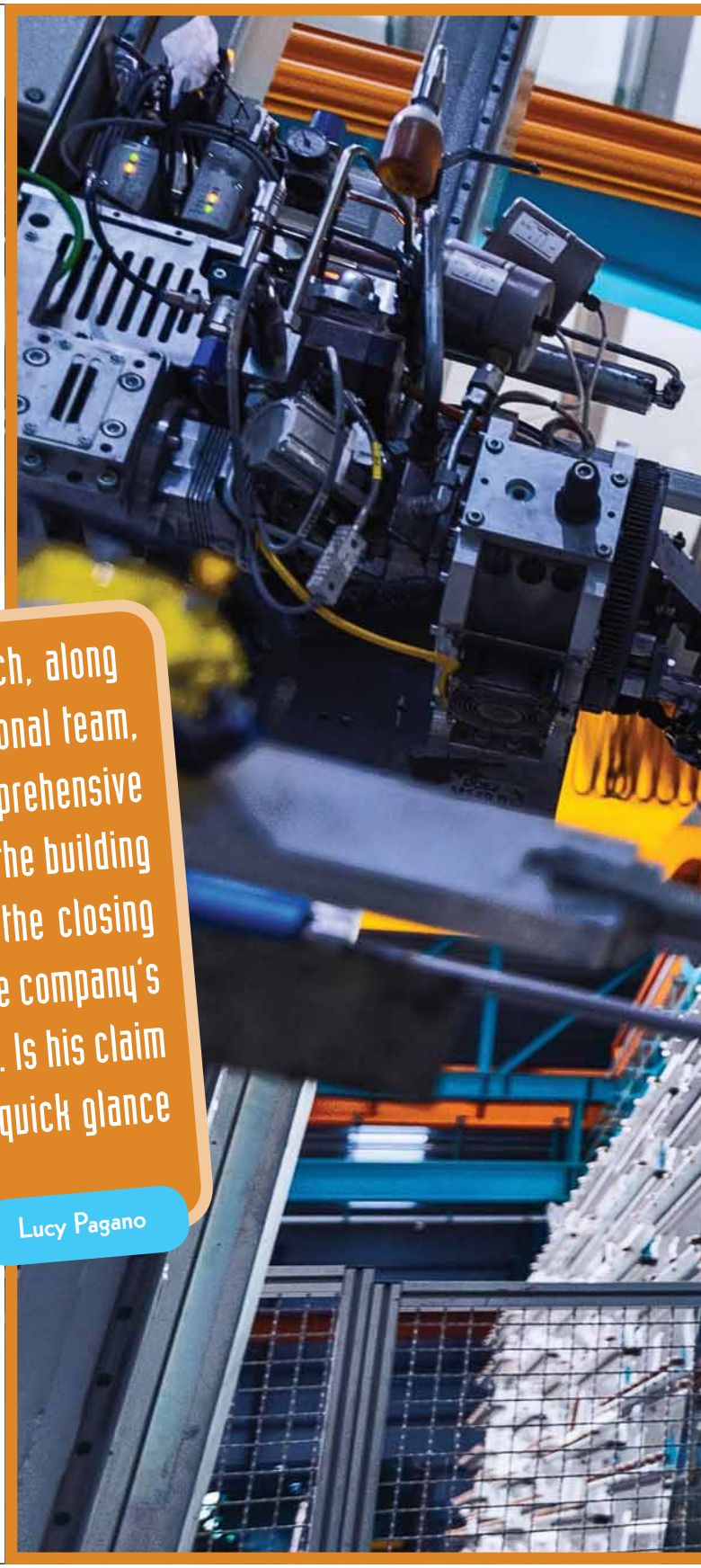
Combi routers, 'two-in-one' products, that associate a traditional sector router with a trapezoidal or groove router, allowing for dual use, are continuing to be in great demand. This router is obviously available in different diameters.

Improving performance and yield

In this product area, thanks also to important recent investments, BDT is developing new technological solutions to improve performance in terms of speed and yield: by working on the design of the sectors, smaller and closer together, the routers enable to reach speeds 50 per cent higher than traditional ones.

Tvitec

GLASS FROM ANOTHER DIMENSION



"Our commitment to innovation and research, along with the training of our human and professional team, will keep TVITEC at the forefront of the comprehensive transformation of high-performing glass in the building of the present and the future." These are the closing words of TVITEC's CEO, Mr. Javier Prado, at the company's annual presentation of corporate memories. Is his claim of leadership well-founded? Let's take a quick glance at its track record.

Lucy Pagano

THE COMPANY

TVITEC, founded in 2008 and with HQ in Cubillos del Sil (León, Spain), has become one of Europe's major companies in the transformation of architectural glass. Its pursuit of sustainability and energy efficiency coupled with its aesthetically pleasing creations, has attracted international clients, such as construction companies, specialist in building

facades, architects and engineers.

One of the company's future achievements is manufacturing 15,000 square meters of glass for the new Google HQ in Mountain View, California. The use of insulating glass and digital printing along with special tempering and lamination processes will make this location unique, safe, soundproof and energy-efficient.

COMMERCIAL FOOTPRINT

With great diligence and professionalism, TVITEC reached its eleventh consecutive record in 2018 as Spain's leading manufacturing glass company due to its high export sales to the US and Europe. That

> All the architectural glass products manufactured by TVITEC are special. They are glazing solutions which adjust exclusively to each project, due to their features, shape, size and aesthetics.

same year TVITEC obtained an increase:

- In the company's turnover, which reached EUR 123.5 million
- In the company's staff, reaching 500 employees
- In the company's volume of contracted projects.

TVITEC's double- and triple-glazing glass with intelligent, selective and solar control coatings can be found in 50 countries on five continents (Europe, Africa, America, Oceania and Asia/Middle East).

TVITEC's four fully automated factories – two in Spain, one in Brazil and one in the Canary Islands – meet the production challenge head on with innovation and agility, with high technology equipment, qualified personnel and competitiveness ratio. One of these factories, specializing in curved glass, was completed in May 2018, which testifies to the company's continuous aim to offer state-of-the-art facilities and best quality to its clients.

PRODUCTS

TVITEC prides itself in being able to take the most specific and demanding requirements of its clients and turn them into a reality. There are no obstacles that TVITEC cannot overcome. The company's track record in processing pieces up to 12 meters long of double and triple glazing on a single sheet is proof of this. TVITEC's array of products go from safety and soundproof units to screen printed and insulating glass in double and triple glazing; from oversize pieces of 12 meter long single sheets to recyclable stone effect glass.

Here are just a few examples:

- ISOLAR SOLARLUX: Insulating glass with solar control coating which benefits building temperature control and contributes to energy saving and construction sustainability.

- ISOLAR AKUSTEK: Insulating glass unit that provides high performance solutions for soundproof buildings and offices.
- TVITEC DURITEC: Safety glass made up of a simple glass pane heat strengthened, tempered or tempered+HST that increases its thermal and mechanical resistance. In the case of breakage, its fragments are harmless.
- TVITEC LAMISTAR: Safety glass made up of two or more pieces of glass joined together by a plastic foil or interlayer. In the case of breakage, its fragments remain attached to the interlayer. It also reduces UV rays incidence and it allows the use colour foils in order to achieve specific aesthetic results.
- TVITEC SCREEN-PRINTING: All types of images can be screen-printed on this glass with coloured paints vitrified on the surface and applied with conventional or digital processing. The quality is warranted over an extended period due to its thermal processes that give resistance, durability and colour stability.
- TVITEC OVER SIZE: Glass pieces of over 12 meters long in double- or triple-glazing on a single unit, with no joints; up to 12,000 x 3,210 mm in different thicknesses. All of which can be screen-printed or

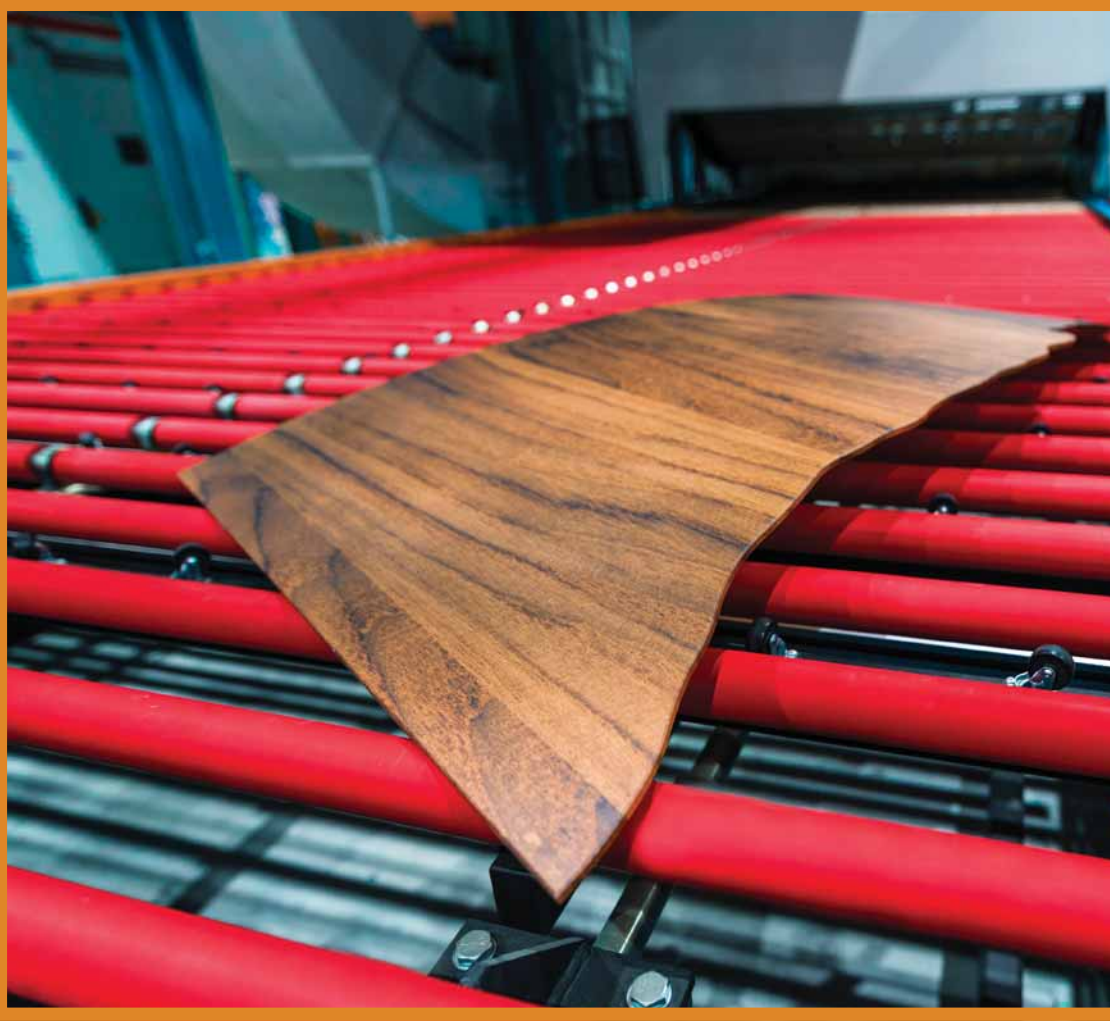
become tempered safety glass of all shapes, ranges, manufacture and finish. They can be used for enclosures, podiums or entrances. Maximum safety, energy-saving and reduced installation costs. Oversize pieces of glass allowing magnificent unobstructed views without divisions; it contributes to energy efficiency by minimizing emissions; resistant to strong impacts and soundproof.

TOTAL QUALITY

TVITEC holds its entire company structure to the highest standards of sustainability. All its departments have strenuously worked to achieve the ISO 14001: 2015 Environmental Management Certification regarding recycling and efficient water and energy management. TVITEC's past, present and future quality strategy covers the three areas of sustainable development: economic growth, social inclusion and environmental protection.

TVITEC also guarantees high-grade quality by utilizing the most advanced technology in fully automated factories. This is exemplified in:

- the curved glass factory in Ponferrada, Spain, that has avant-garde equipment for cutting and manufacturing, modern furnaces for tempering and laminat-



Rocalux glass

ing plus a painting line.
- the plant of Villena (Alicante), that among others uses high technology machinery for cutting and manufacturing, a modern roller painting for full coverage painting, a tempering furnace, and lines for double-glazing, laminating and matting.

SOCIAL COMMITMENT

TVITEC incorporates its social commitment into its business model of CSR (Corporate Social Responsibility). The company promotes communication and dialogue by:
- Supporting charities and food banks
- Assisting organizations that deal with the integration of marginalized people
- Taking part in donation campaigns and fund raisings
- Promoting dialogue at local training centres and universities.

After this quick glance at TVITEC's claim of leadership, we must admit that TVITEC's business model, culture and identity combined with its high quality production processes support its motto of "glass from another dimension".

Dieffe Macchine

"LET'S BE CLEAR ABOUT WATER!"

Enrico Bonanni, *Sales Manager*
Dieffe Macchine

Environmental issues and protecting the environment for future generations are now legal requirements for manufacturers, who must have a sustainable and cost effective waste management programme. Dieffe Macchine gives us an idea of how its centrifugal water treatment systems can be used by glass processors to increase productivity, decrease downtime, improve running speeds, and produce better quality products in an entirely environmentally friendly manner.

Dieffe Macchine of Italy has the answer for all glass processing companies, in the form of centrifugal water treatment systems. These systems are completely environmentally friendly. Enrico Bonanni, Sales Manager at Dieffe, gives a little more insight into the company and their equipment.

WATER TREATMENT

Dieffe Macchine is a dynamic and evolving company, overseeing the market with the design and construction of water treatment equipment. With more than 20 years experience and know-how, they design and manufacture systems for recycling water from glass processing such as grinding, painting and any applications involving the recovery and reuse of waste water. The centrifugal technology separates solids from liquids without any chemical additives (flocculants), which can be environmentally hazardous, and corrosive to metal parts, recovering the solids in dry form, allowing immediate disposal of the waste.

Many glass processors and fabricators are still cleaning out their coolant tanks by hand, or they are using ineffective underground settling tanks. These traditional methods simply do not solve the problems, and continue to result in lost machine time – and profits – during clean outs,

> Water is a very expensive consumable!

increased labour, disposal and coolant costs, along with other typical problems caused by dirty coolant. By using a suitable centrifuge water treatment system, you can solve these issues.
Technical staff are on hand to conduct feasibility studies, to support customers with accurate and economical assessment of requirements, and to ensure the viability of each project. Dieffe Macchine can supply a standard 'off the shelf' centrifuge, or build a system tailored to specific needs.
Dieffe Macchine offers a wide range of reliable, easy to operate, solid and liquid separation equipment including, manual centrifuges, automatic centrifuges, fine filtration, micro filtration, reverse osmosis, and complete factory plants. The use of this equipment results in increased productivity, decreased downtime, improved running speeds, producing better quality end products by using cleaner water.

DIEFFE – THE COMPANY, ITS VISION AND MISSION

Dieffe designs, manufactures and installs plants for the treatment and recycling of water from the glass processing such as

grinding, painting and all applications involving the use and recovery of waste water.

Centrifugation technology allows to separate liquids from solids, returning them in dry form, which can be immediately eliminated, without any chemical additive (flocculant), which can be corrosive to metal parts.

Dieffe Macchine is very sensitive to problems related to environmental pollution, for almost 20 years it has been dedicated almost exclusively to the construction of centrifugal machines of various capacities, as well as water treatment and filtration systems.

Since 2002, the company has supplied all types of manual and automatic centrifuges to Forza g and GTech.

> Let's work together to reduce the environmental impact of wastewater!

PRODUCTS

Dieffe centrifugal separation systems are, today, considered the most high-performing on the market. The range is divided into four series, DFL 50 M, 50 MMF, 150 A and 250 A, with variables for all glassware needs.

The 50 series is designed to be installed indoors, while the 150 and 250 can also be installed outdoors with any type of protective covering.

The DFL 50 M is intended to serve one or two machines such as a grinding machine and an NC, with alternating water sampling; the 50 MMF is equipped with a Micro Filter and allows to obtain very pure water of 1 to 3 μ microns.

The range also includes the DFL 150 and 250, for companies that have to process volumes up to 120 m³/hour and more. The 150 and 250 versions can also be associated with the Micro Filter to supply water with particularly low filtering.

All machines are equipped with an electrical system on board, pre-programmed according to customer requirements, but retaining the ability to be managed directly by a simple control panel.

Dieffe Macchine Srl

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We are coming...

are you ready?

SGM - Italy

Glass for Europe
Green Deal Action Plan

"The European Commission's announcement on the Green Deal and Climate Law has generated high expectations. We need to build on this momentum to start working with the sectors where solutions are ready to be deployed," said Bertrand Cazes, Glass for Europe's Secretary General.

The Industrial Strategy and the Circular Economy Action Plan cover the legal and industrial challenges faced in reducing emissions, and are a promising start to the carbon-neutral agenda. Since the carbon budget is limited, action could be taken in sectors most likely to reduce emissions faster.

The European Commission outlines the strategies for a climate-neutral Europe in A New Industrial Strategy for Europe and the Circular Economy Action Plan, to be implemented by 2050. Glass for Europe intends to set the ball rolling.

THE VISION

To support the definition of concrete action, in January 2020 the flat glass sector released its vision for a climate-neutral Europe in 2050. This is the result of exhaustive research within the industry on how the sector could optimise its contribution to the carbon neutrality objective.

Cazes: "It is reassuring to read that we share with the European Commission the assessment of the challenge ahead: the need to continue providing the materials required for the transition in the building and transport sectors at a competitive price, while at the same time reducing our own manufacturing emissions. The task is daunting, but our sector is willing to contribute."

OMISSIONS

The flat glass sector and Europe's industrial strategy are mainly on the same page as far as investment in renewable energy infrastructures or the support for research and development are concerned. However, in the manufacturing emissions field, all renewable energy sources aren't taken into consideration and the strategy omits carbon capture storage infrastructures which would be required in particular by sectors with process emissions. In terms of market activation for production, the strategy limits itself to touching on the need to create new markets, while studies show that existing markets, such as the construction sector, are functioning far below their reduction potential due to the use of sub-optimal products.

NEED FOR DIALOGUE

Glass is a resource and recycling glass to replace virgin raw materials is good for the environment, the climate, and the economy. While the flat glass sector has successfully worked on closing the industrial recycling loop, it is estimated that 40 per cent additional recycled glass could be used if end-of-life building glass was entirely recycled. Glass for Europe is eager to engage in dialogue with strategists to support this and is looking forward to contributing to the discussions on Sustainable Built Environment, the need for material special recovery targets or the implementation of by-products status across the Member States.

Tecno-Glass

TOP-LEVEL PRODUCTS FOR THE PRESENT AND THE FUTURE

MFC-Rocker

FOUNDED IN RESPONSE TO MARKET AND CLIENT NEEDS

Tecno-Glass srl was founded in 1990, following on from Tecno Glass snc (founded in 1986), on the basis of the first sole proprietorship company Canzano Franco, founded in 1980. The Canzano Franco company was set up following the ideas of Mr. Canzano who, as a dealer in glass, was a regular visitor to glassworks in the Abruzzo area of southern Italy, and where he discovered that glassmakers there were in difficulty with regards to supplies of even the simplest tools and equipment, which had to be ordered from companies based in northern Italy.

His first goal was therefore to provide a faster service to glassworks by setting up a small warehouse for accessories such as seals, silicone and Thiokol cartridges, glass wedges, stucco, rulers, set squares, and glass cutters.

THE PRESENT DAY

Company headquarters with offices and workshop are located in in Ortona, Chieti, where activities such as marketing and sales, as well as light processing are carried out on an area of 2,600 square metres. The company's workshop, technical and planning departments

Looking at the companies who actually make the machinery used each and every day by the glass industry and glass processors, we can see that they are a fundamental part of the industry. In this article, we speak to one of these companies – Tecno-Glass – about how it has grown in recent years, and how, with its most recent machines, the company is looking to expand globally.

are located at a second premises of 800 square metres in Poggiofiorito, Chieti, while a warehouse of 200 square metres is located in Caltanisetta, Calabria.

All together, the company now has 26 employees, and is headed by Franco Canzano – CEO, Sandro Canzano – Product Manager, and Manuela Canzano in the Sales and International Department. Company turnover in 2019 was EUR 11,700,000.00, a 30 per cent increase compared to 2016.

SERVICE AND ASSISTANCE AS FUNDAMENTAL CHARACTERISTICS

Over the years, the experience of Tecno-Glass as dealers in glass tools and equipment have led the company to be convinced that assistance and service for clients is fundamental. Dealers, in fact, must always guarantee the best products for their clients, and this is where Tecno-Glass' experience as designers and manufacturers of machinery

and plants has enabled the company to provide top-level products thanks to par excellence processing.
The company's assembly process has, in fact, become ever more advanced, recording all stages of the production process, starting from the body of the machines, passing through plant engineering, software, up to final testing. All this allows to have a detailed history of all machines, which, in turn, ensures prompt and efficient assistance.

MARKET, SALES AND EXPORTS WITH NEW PRODUCTS

International sales are 15 per cent of the company's turnover, with exports mainly concerning sales of Tecno-Glass' own production, such as extruders, butylers, profile cutters, gas loaders etc., with main areas of export being Spain, France, UK, Russia, Romania, Brazil, Malta, Albania, Morocco, Tokyo, etc.. The international market, in fact, is fundamental for sales of Tecno-Glass' machinery, and it is precisely on the international market that the company will be aiming in the years to come.

MFC-RADIANT

Tecno-Glass' work is focussed on the flat glass sector, and more precisely that of double-glazing. These two sectors are then followed by metal accessories and handrails, with a profile manufactured by the company called Prisma Evolution.
At the end of 2018, Tecno-Glass launched Antiuragano – a laminate sheet that significantly strengthens the rigidity of laminated glass (certified product).
The company is now working to register a trademark on its precision rotor extruder, an innovative machine in the sector of the supply of two-component sealants, never seen in the glass sector.
These products will be on show at a trade event in the US this year – a new market for Tecno-Glass.

PRODUCT RANGE

Tecno-Glass' main products are top of the market high-tech sealing and glueing machines with high standards for all components.
The company's most recent machines are the MFC –ROCKER extruder, with high flow rate and extremely precise dosage, and the new BRX-1400 butyl extruder, the advanced version of the BRX-700, now with fully automated settings. Both machines meet Industry 4.0 requirements.

R&D AND MARKET DEVELOPMENTS – INDUSTRY 4.0

Research and development is part of the daily activities of Tecno-Glass, both in the search for components, which are often developed together with suppliers, as well as during the studies of the optimal logic of machinery that today can now be refined more and more thanks to latest-generation PLCs, leading leading to complete remote control of our machines.

TKD-3000 PLUS

This work is carried out in response to a market which is ever more aware that buying high-end reliable machines is the solution to most problems. Quality production implies investing in reliable machines and using optimal products.

Industry 4.0 has had absolutely positive effects at Tecno-Glass, first of all with the investment in a Made in Italy electronic warehouse in 2019, providing total management of goods in stock, and then with the integration of 4.0 technology in the company's latest generation machines.

TECNO GLASS Srl

TECNO GLASS

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GGF

HELPING CONSUMERS UNDERSTAND THE LIFESTYLE BENEFITS OF GLASS

James Lee, *Director of External Affairs*
The Glass and Glazing Federation

The Glass and Glazing Federation (GGF) is the UK's glass industry's main trade federation. Formed in 1977, many GGF member companies were founder-members and all new companies that join have to meet the high standards set by the GGF.

GLASS – AN EVERY-DAY MATERIAL WITH NUMEROUS BENEFITS

Glass is an everyday material that is often under-rated and even taken for granted. However, the technology and benefits of glass are much more than meets the eye. Using the right type of glass can keep you warm and reduce your energy bills but also protect you from sunlight and your house overheating. It can improve your open plan living experience with more natural daylight and ventilation but also keep your home safer and more secure.

Using the right type of glass and glazing systems can also reduce unwanted noise entering your home and can help keep noise inside the rooms in your home. The benefits of glass also extend to making your home more private and also more stylish with some great ideas for the interior spaces throughout your home.

Glass can make a big difference to your lifestyle and the choices now available are wide and varied, whether you are installing replacement single-, double- or triple-glazed windows and/or doors or using glass to improve other parts of your home.

Homes in particular, should be spaces we feel secure and calm in so creating a healthy living space is key. In light of this, and with so many health benefits associated with the use of good quality glass in the home, the Think Glass hub is the go-to place to find all the information about glass and glazing.

THE THINK GLASS HUB

The GGF's Hub is split into six different sections, and each section contains feature articles produced by the MyGlazing team in collaboration with the UK's main glass manufacturers including; Saint Gobain, Guardian, AGC and Pilkington NSG.

The Think Glass hub will also feature articles based

Think Glass

Using the right type of glass in your home can make an important difference to your lifestyle: reduce energy bills, protection from sunlight and overheating, reducing unwanted noise, just to name a few. The UK's Glass and Glazing Federation has set up the Think Glass hub, with all the information needed to make informed decisions about glass and glazing.

on the views of homeowners. MyGlazing.com has commissioned an independent survey –and here on the Think Glass hub we will be sharing the views and opinions of other homeowners who are using or considering using glass to improve their homes and lifestyles.

MAKING A DIFFERENCE TO YOUR LIFESTYLE

Making your home warmer and more comfortable is more important than you might think. It may sound obvious but living in an environment where there is a consistent warm temperature, good ventilation and natural light are important to maintain good health.

In fact, according to the UK's NHS website, exposure to damp and mouldy environments can cause a variety of health effects such as; nasal stuffiness, throat irritation, coughing or wheezing, eye irritation and skin irritation.

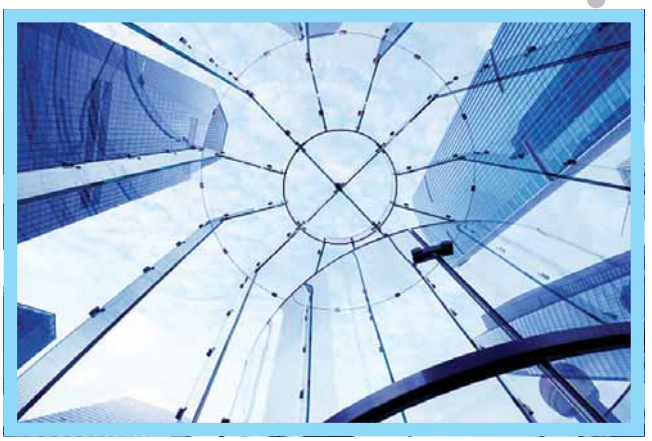
On the more extreme side, people with weak immune systems can suffer serious infections, especially in their lungs when they are exposed to damp and mouldy conditions.

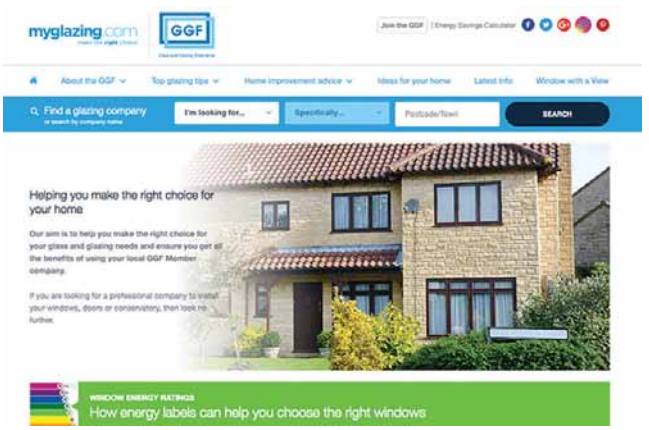
Furthermore, research by the Institute of Medicine (IOM) has found there was sufficient evidence to link indoor exposure to mould and damp as contributing factors to coughs and wheezing in otherwise healthy people, as well as an increasing the symptoms that asthma sufferers experience.

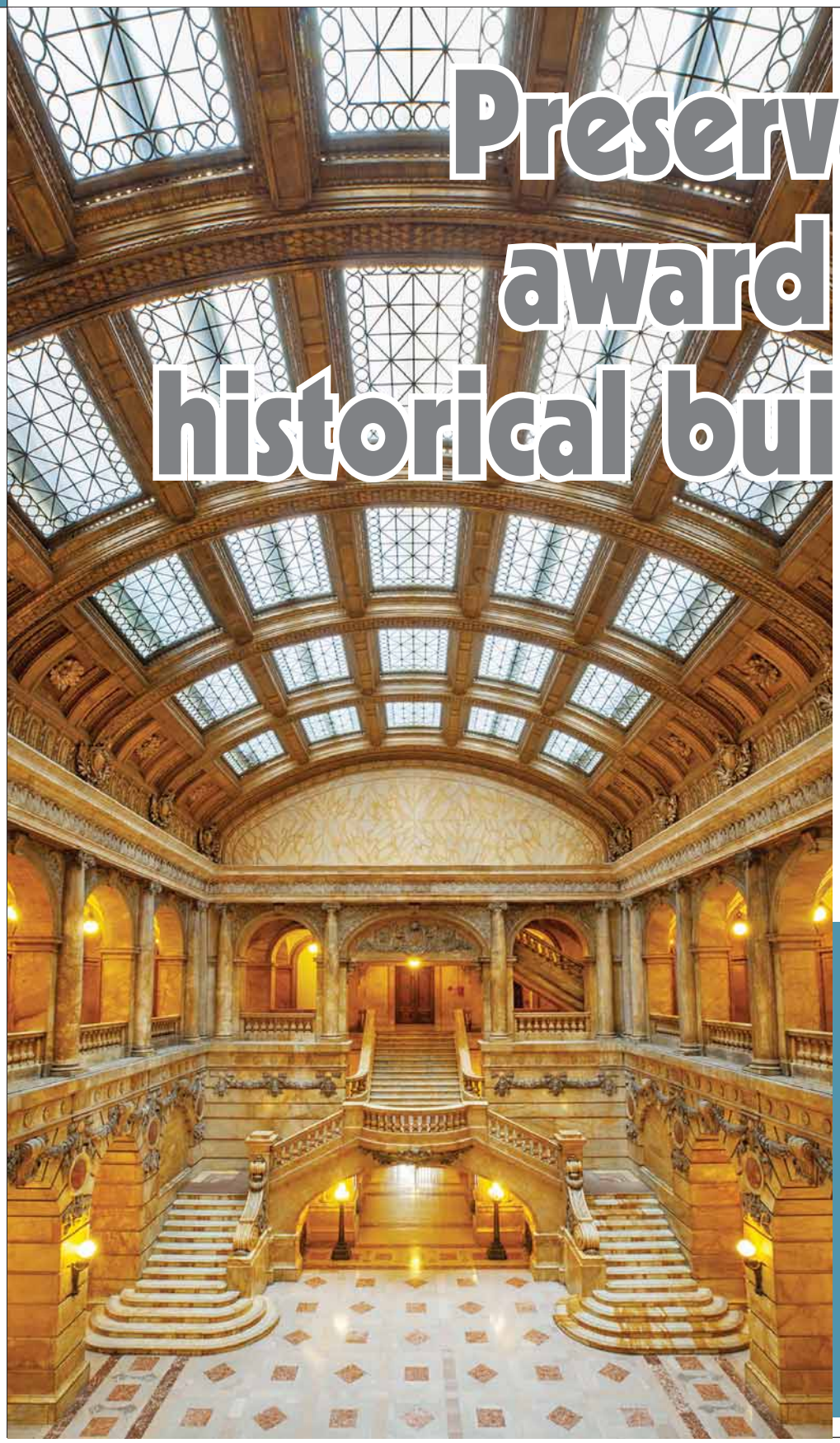
The detrimental health issues described earlier can be avoided if your home is improved with modern construction materials, high standards of installation and a sensible approach to how you use energy and how you live in your home. For example, if your home has modern energy efficient windows and doors, it should also have good ventilation – this prevents moisture hanging in the air and condensation gathering on cold surfaces from which mould can develop.

James Lee, Director of External Affairs for the Glass and Glazing Federation commented, "It is clear that health can be affected if a home has inefficient glazing. With up to 24 per cent of heat energy potentially leaving a house through poor quality windows and doors, I would advise anyone living in a home that is cold, draughty or lacking good ventilation to look at replacing their old windows and, or doors. Not only to reduce fuel bills and add value to their property but to improve or maintain their health."

Homeowners are clearly listening to the experts. In a recently independent survey of 4,000 homeowners conducted by One Poll on behalf of the Glass and Glazing Federation (GGF), it was revealed that one in three people replace their windows or doors because their house was draughty or damp with over four in every ten homeowners replacing windows and doors to improve their house's energy efficiency to make their homes warmer.







Preservation award for a historical building

THE 1907 BEAUX-ARTS BUILDING - A NATIONAL HISTORIC AND NEW YORK CITY LANDMARK

The replacement and restoration of the historic skylight within the landmark Manhattan Surrogate's Courthouse has received

The original skylight monitor consists of two separate glazed assemblies with an interstitial space in between. The outer assembly faces the sky and provides protection from the weather. The interior glass layer, or "laylight," is seen by the public from within the atrium, and is therefore treated in a highly ornamental fashion. Urbahn Architects and Jablonski Building Conservation developed a procedure that called for removing the glass panels to facilitate the restoration of the leading that holds the glass in place, as well as provision of new glass to replace missing or broken panes. The bronze cladding was stripped of all coatings, cleaned, and refinished in situ.
Photo by Ola Wilk/Wilk Marketing Communications

The replacement of the Beaux-Arts Skylight at Historic Manhattan Surrogate's Courthouse by Urbahn Architects, NYC Department of Design and Construction, and Jablonski Building Conservation has received the Lucy G. Moses Preservation Award from the New York Landmarks Conservancy. This article gives us an idea of the work behind this important replacement and restoration, and the history of this landmark building both for New York and the United States.

a 2020 Lucy G. Moses Preservation Award from the New York Landmarks Conservancy. The team for this highly complex project included Urbahn Architects, program manager New York City Department of Design and Construction (DDC), owner New York City Department of Citywide Administrative Services (DCAS), and historic conservator Jablonski Building Conservation (JBC).

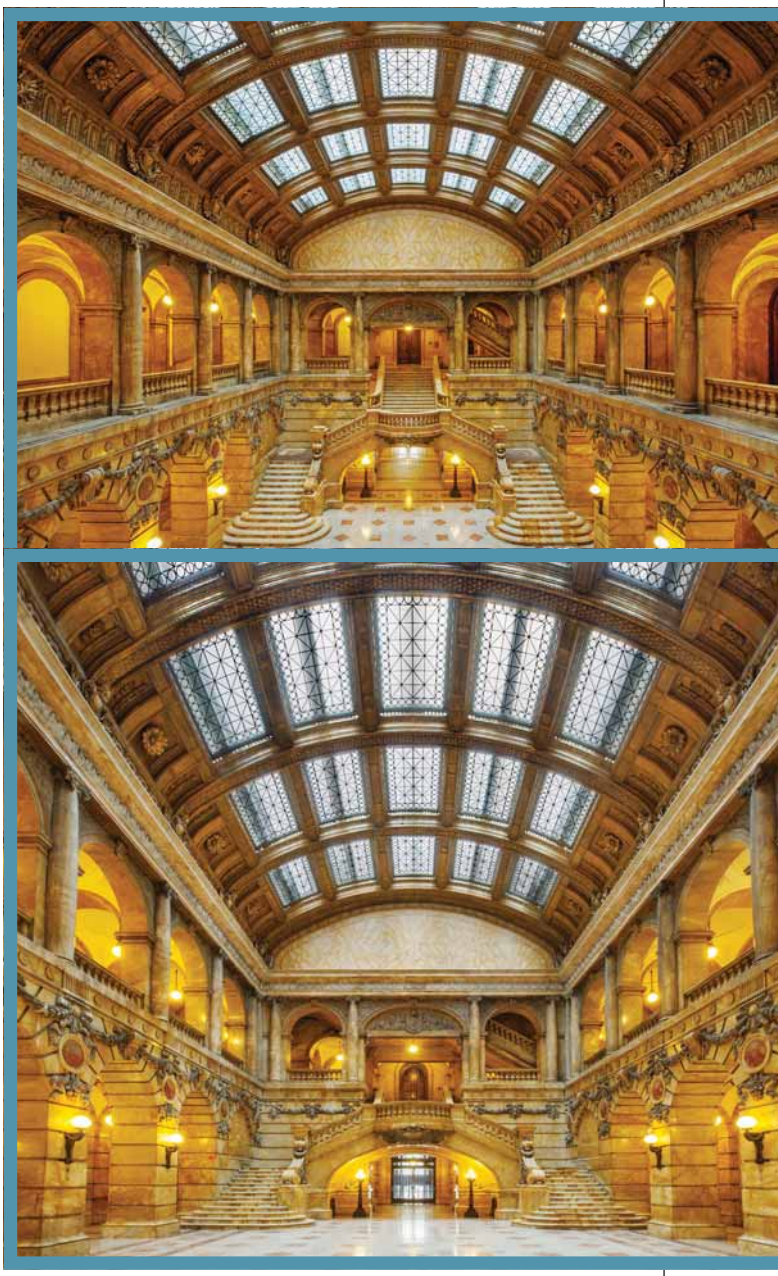
The Lucy G. Moses Awards are the New York Landmarks Conservancy's highest honors for preservation excellence. The award will be bestowed upon the project team on 23 September 2020, during the 30th Anniversary Lucy G. Moses Preservation Awards Gala to be held at The Cathedral Church of Saint John the Divine in Manhattan.

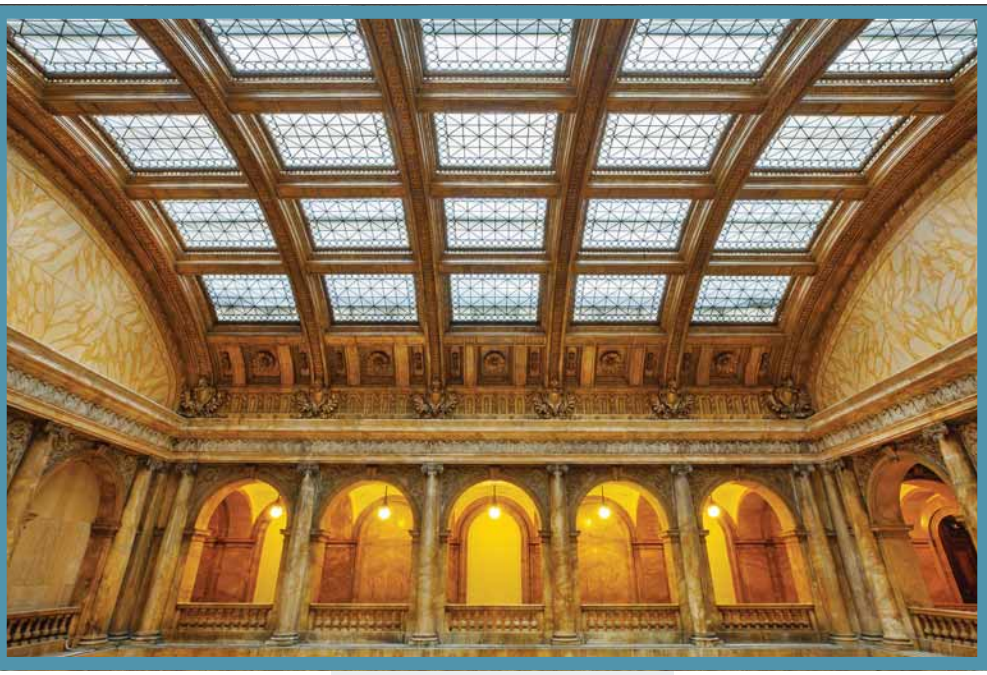
Completed in 1907, this Beaux-Arts structure encompasses an entire block in downtown Manhattan, bounded by Chambers, Centre, Reade, and Elk Streets. The interior and exterior are both New York City Landmarks. The building was also placed on the National Register of Historic Places in 1972 and designated a National Historic Landmark in 1977. The building holds the city's municipal archives and features ornate courtrooms for New York County's Surrogate's Court on the fifth floor.

MASTERPIECE OF JOHN R. THOMAS

John R. Thomas, one of the United States' most sought after architects of public edifices in his day, designed the seven-story building. Thomas considered this building his masterpiece. The opulent three-story

The replacement and restoration of the historic skylight within the landmark Manhattan Surrogate's Courthouse by Urbahn Architects, the NYC Department of Design and Construction, and Jablonski Building Conservation has received a 2020 Lucy G. Moses Preservation Award from the New York Landmarks Conservancy. Due to the grandeur of the atrium, the interior is often used as the backdrop for the filming of movies and commercials, and it is frequently rented out as an event space. The television show "Law and Order", "The Devil Wears Prada" and "Great Expectations" movies, and many other productions feature scenes shot within the building.
Photo by Ola Wilk/Wilk Marketing Communications





The leaded glass laylight panels were removed and crated for restoration by Bovard Studio. The lead cames were heavily fatigued and failing, having exceeded their practical life span. New reinforcement and new lead caming was installed. The team carefully selected new etched glass to match the texture and translucency of the original.
Photo by Ola Wilk/Wilk Marketing Communications

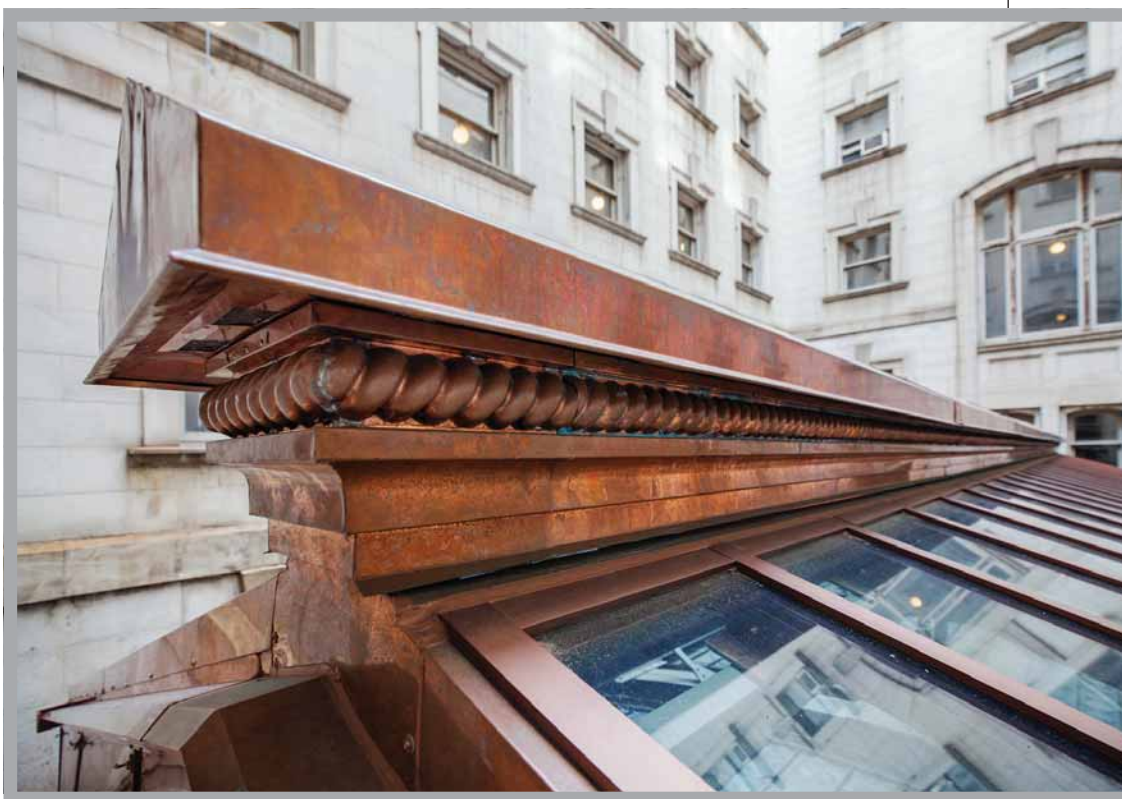
atrium features a 40 foot by 60 foot skylight that soars overhead, allowing natural light to flood in, illuminating the rich and highly articulated interiors. The Paris Opera purportedly inspired the skylight, and in fact, when the court building was completed it was called the most Parisian structure in New York.
While many of the courtyard's sumptuous finishes were imported from Europe, the skylight was fabricated just a couple of dozen blocks north of the building itself, in Chelsea. The monumental atrium space features an extraordinary double staircase of Tuscan marble imported from Siena, which leads to upper-level balconies. The walls and columns are lined with matching Siena marble, with blood-red marble roundels and elaborate carvings that include garlands of fruit and foliage. Mosaic murals by William DeLeftwich Dodge feature the signs of the zodiac. For the floor, the original architect chose pink marble from Tennessee and blue marble from Belgium, laid out in geometric patterns. When it was built, this atrium was the grandest, most expensive, and most controversial – due to the cost and opulence – part of the building.
The original skylight monitor actually consists of two separate glazed assemblies with an interstitial space in between. The outer assembly faces the sky and provides protection from the weather. The interior glass layer, or "laylight," is seen by the public from within the atrium, and is therefore treated in a highly ornamental fashion. In addition to its visual function, the laylight provides code-required occupant protection from potentially falling glass. The monitor that projects from the roof is gable-shaped, with glass panels originally supported by a copper frame structure with a ridge at its peak. Ten clerestory windows are on the vertical sides where the skylight drops to a walkway that stretches around its perimeter. The walkway extends along the built-in gutters at two sides and consists of hexagonal glass block set within cast iron panels. The laylight within the atrium is comprised of hundreds of translucent glass panels set in an ornamental bronze clad cast iron frame forming a monumental barrel vault.

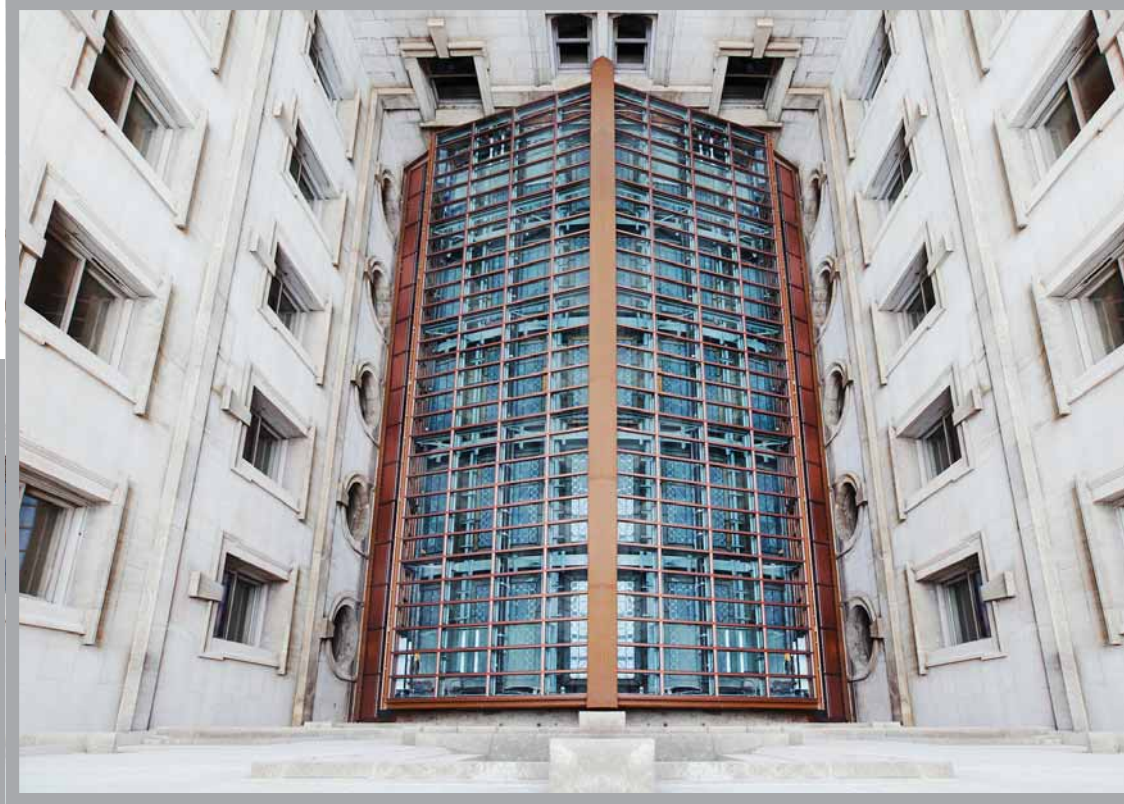
THE RENOVATION TEAM'S WORK FOLLOWING URBAN'S DESIGN

Based on Urbahn's design, the renovation team removed the entire outer monitor system and replaced it with a new copper-anodized aluminium frame to emulate the original copper frame cladding. The team oversaw the fabrication of a new aluminium frame to hold the glass panels. Several new copper elements were fabricated to match the originals, including leaders, gutters, and a ridge vent replicating the original ornate rope motif.
For the laylight, Urbahn and JBC developed a procedure that called for removing the glass panels to facilitate the restoration of the leading that holds the glass in place, as well as provision of new glass to replace missing or broken panes. The bronze cladding was stripped of all coatings, cleaned, and refinished in situ.
The design team addressed the inherent vulnerability of the glass block walkway to water infiltration by designing a new protective assembly, including laminated glass protecting the glass blocks, with new du-

rable aluminium panels as a walking surface, all within a new metal frame system. The team replicated the original hexagonal glass blocks, which are 1-½" thick, 3-½" wide, with groups of blocks forming a total of 24 glass panels running on two sides of the skylight.

"Working within a cherished historic edifice such as Surrogate's Court required a team that is attuned to the aesthetics, materials, and building practices of another age, as well as well versed in both the limitations and advances of modern construction technologies," explained Rafael Stein, AIA, an Urbahn Principal. "For example, the two lunettes on either end of the atrium had been so damaged that it was nearly impossible to understand what they had once looked like. Our research revealed that there had in fact been different decorative layers over time. We selected the





Based on Urbahn Architects' design, the renovation team removed the entire outer monitor system and replaced it with a new copper-anodized aluminium frame to emulate the original copper frame cladding. The team oversaw the fabrication of a new aluminium frame to hold the glass panels. Several new copper elements were fabricated to match the originals, including leaders, gutters, and a ridge vent replicating the original ornate rope motif. *Photo by Ola Wilk/Wilk Marketing Communications*

Molds for new glass blocks were taken from castings of existing blocks. New hexagonal glass blocks were casted by Gillinder Brothers to match the originals, including the embossed snowflake pattern on the surface, while Wemco Casting fabricated new cast iron frames. *Photo by Ola Wilk/Wilk Marketing Communications*

most recent iteration and developed a restoration approach based on review of archival photographs and an analysis of multiple paint and plaster coats. We then carefully specified the design so that the lunettes could be lovingly restored by experienced artisans."

Although the skylight first began to leak in the 1990s, rehabilitation was postponed because of the near constant use of the building. In addition to its municipal use, the building hosts major public and private events and is rented out as a film set. By the time the restoration had begun, the atrium's grandeur was diminished by the damaged and grimy skylight and extensive damage to adjacent materials, including marble and plaster.

"There was water damage to the cornices beneath the skylight. The original marble was extremely difficult to match, so, in all locations where damaged marble was in prominent view, we carefully pinned the sections together," said Stein.

In addition to DCAS, DDC, Urbahn, and Jablonski, the team included construction manager The LiRo Group; general contractor BQE Industries, Inc.; and structural engineer Ysrael A. Seinuk. Instrumental subcontractors included Bovard Studio, Inc., which restored the laylight glass; Wemco Casting, LLC, which produced the cast iron frames; Gillinder Brothers, Inc. which cast the new glass blocks; Linel, which fabricated and installed the skylight; and EverGreene Architectural Arts, which recreated the lunettes and the ornamental bronze cladding that encases the skylight's steel structure. EverGreene also painted the repaired plaster to match the marble panels.

COMPLEX LOGISTICS

The construction team was operating in a tight space within a historic structure, so logistics were carefully planned. First, crews erected barricades within the atrium to safeguard the public while they installed a working platform resting on scaffolding, with a stair access to the skylight from below. The construction team also provided temporary roof to make the atrium watertight during construction. The temporary roof consisted of steel beams spanning the courtyard, with metal deck

and waterproof membrane. These components were hoisted over the building's main roof and assembled in place over the skylight within the courtyard, surrounded on all sides by the Court building's tower. Select skylight components designated for removal were manually disassembled and hoisted down within the building from the working platform. The temporary roof was then disassembled and removed by crane from the street, once the renovation was completed. In addition, there were multiple security restrictions, as the building remained a working courthouse that required heightened security. Security personnel constantly monitored each entrance. As it is an occupied building, there was also an increased need for noise control; the construction team had to carefully coordinate their work with tenants.

Due to the grandeur of the atrium, the interior is often used as the backdrop for the filming of movies and commercials, and it is frequently rented out as an event space. The television show "Law and Order", "The Devil Wears Prada" and "Great Expectations" movies, and many other productions feature scenes shot within the building. Construction could not commence until the multitude of such pre-booked shoots and events taking place immediately below the skylight work occurred. No events were scheduled during the construction period.

Some of the original steel frame elements supporting the skylight were corroded or missing due to years of water infiltration and deferred maintenance. Overall, the project involved a great deal of on-site research, because there were no original drawings. Engineering consultant Ysrael A. Seinuk PC prepared new drawings based on field measurements and developed a restoration method for the structural aspects of the project. "We found that numerous structural elements that support the skylight had to be replaced or reinforced," noted Salvatore Paratore, AIA, LEED AP, the Project Manager for the work and a Senior Associate at Urbahn. "For the temporary roof, we lifted the steel up for installation using a hoist set up on a scaffolding platform above the work area. All of the other materials and equipment were brought up by an internal hoist," Paratore added.

RESTORATION PROCESS DETAILS

JBC worked with Urbahn and DDC and DCAS to develop a scope of work and procedures to repair and restore the historic elements on the interior and at the skylight level. Prior to any work beginning, Urbahn's team surveyed and documented the existing conditions, including the exterior skylight monitor, leaded glass laylight panels, the bronze-clad barrel vaulted frame, and the plaster lunettes. The design team conducted their survey from a lift so that materials could be inspected up close. The design team also surveyed the skylight's elements from within the interstitial space between the monitor and laylight.

The inspection included documenting each of the glass laylight panels, including the condition of the leading and the glass panes. The top-facing, unfinished side of the bronze was in good condition. However, because the bronze cladding concealed the cast-iron frame, the full extent of corrosion from water infiltration was not evident until the construction phase. During design, Urbahn and JBC determined that a significant percentage of the glass blocks at the exterior walkway were cracked or missing, thereby requiring casting of replacement blocks and frame to replicate these elements. The plaster substrate of the lunettes had blistered and much of the paint was peeling.

Mary Jablonski, JBC's Principal, also noted that scaffold access revealed multiple unforeseen conditions, including marble spalls, cracks, and losses on the cornice. "Many of the marble spalls were due to corrosion of the structural steel, which was assessed and then repaired. Work on the marble cornice could not be completed until the scaffold was modified to provide a lower work platform below the cornice fascia. Once the work platform was modified, the marble cornice and fascia were vacuumed to remove dust and debris. Then they were cleaned using a latex-based cleaner in order to minimize the amount of water used. Cracks and spalls were then identified and repairs were made using tinted epoxy and the dutchman method," she explained.

PROJECT ELEMENTS

Glass laylight panels

The leaded glass laylight panels were removed and crated for restoration by Bovard Studio. The lead cames were heavily fatigued and failing, having exceeded their practical life span. New reinforcement and new lead caming was installed. The team carefully selected new etched glass to match the texture and translucency of the original.

Glass block panels

While the original intent was to salvage as many glass block units as possible and install replica units to replace damaged ones, extensive corrosion of the cast iron frames made it impossible to remove any units without breaking

them. Instead, molds for new glass blocks were taken from castings of existing blocks. New hexagonal glass blocks were casted by Gillinder Brothers to match the originals, including the embossed snowflake pattern on the surface, while Wemco Casting fabricated new cast iron frames.

Plaster lunettes

Based on historic photographs, JBC determined that initially the plaster was unfinished. Then it had been painted a pale yellow overlaid with a simple, light stencil pattern. It was subsequently painted with a faux-Siena marble finish in 1933, signed by the artist, Luka Jolis. The team decided to replicate this most recent finish, to match the Siena walls and columns. The lunettes were heavily cracked and the painted finish was actively flaking from the surface. EverGreene repaired the flat plaster using a mesh-and-skim coat system before the lunettes were repainted. The ornamental plaster border was repaired and missing plaster elements were recast before repainting to match the adjacent fire-gilt bronze finish. The painstaking paint detailing included elaborate veining and faux joint lines.

Bronze enclosures

The bronze enclosures were stripped of all finishes and cleaned by EverGreene. To access these enclosures, the team first removed several large bronze garland elements that were bolted to the enclosures. EverGreene cleaned the surfaces with solvents, fire gilded them, and then coated them with Permalac. According to Jablonski, fire-gilding, also known as ormolu, is a process by which an amalgam of gold and mercury is applied to a metallic surface. The surface is heated, which causes the mercury to evaporate and leave the gold particles behind. This surface is then burnished or treated with waxes. The waxes may have additives, such as ochres or verdigris, which when the wax is fired and melted from the surface, leave behind a slightly tinted finish with highlights on the surface. "The overall effect is a rich golden color, chemically bonded to the metal surface, and therefore more durable than a traditional gilded finish. The restored fire-gilt bronze surfaces were monitored throughout construction for any signs of corrosion or deterioration of the finish," stated Jablonski.

URBAHN ARCHITECTS

Urbahn Architects is a full-service planning and design firm based in New York City. Since its founding in 1945, Urbahn has designed projects for organizations and institutions that operate in the residential, healthcare, education, justice, science, transportation, and infrastructure sectors. The firm served as the architect for some of the nation's most iconic structures, including the Vehicle Assembly Building and Launch Control at Kennedy Space Center in Cape Canaveral, FL, and the Fermi National Accelerator Lab in Batavia, IL. Urbahn's annual domestic and international project workload exceeds $500 million in construction value.

Five principals lead the firm: Donald E. Henry, Jr., AIA, LEED AP; Natale V. Barranco, AIA, LEED AP; Martin D. Stein, AIA; Rafael Stein, AIA; and Ranabir Sengupta, AIA, LEED AP.

Urbahn's historic restoration and preservation project portfolio includes the Thurgood Marshall U.S. Courthouse, the City Hall Offices and Emergency Situation Room, and 280 Broadway in Manhattan; the Pelham Bay Park Orchard Beach Bathhouse and six elevated subway stations in the Bronx, NY; nine historic pedestrian bridges in Manhattan, Queens, and Staten Island, NY; the Old Boys High School in Brooklyn, NY; and Madison and Morristown New Jersey Transit train stations in New Jersey.

The firm's work also includes the $70 million Tides North residential development in Arverne, NY; New York City Hall Mayoral Offices and Emergency Situation Center and Public Health Lab Redevelopment Master Plans in New York, NY; Centro Medico Correccional in Bayamon, PR; and Jersey City Municipal Services Complex, Jersey City, NJ; the SUNY New Paltz Engineering Innovation Hub in New Paltz, NY; Lehman College School of Nursing in the Bronx, NY; Usha Martin University Master Plan in Ranchi, India; Columbia University Baker Field Facilities Master Plan in New York, NY; P.S. 253Q Elementary School in Queens, NY; and P.S. 144Q addition in Forest Hills, NY.

JABLONSKI BUILDING CONSERVATION

Jablonski Building Conservation, Inc. is a full-service architectural conservation firm specializing in the preservation of historic buildings, monuments, sculpture, cemeteries, mosaics, bridges, and other cultural resources. Our staff consists of professionally trained architectural conservators. We provide in-depth investigative and assessment services, both in the laboratory and on-site. We take great care to design treatment options for our clients that provide for maintenance as well as conservation.

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Air Products and Chemicals

MAINTAINING FULL PRODUCTION IN FURNACES WITH FAILING REGENERATORS USING OXY-FUEL COMBUSTION

William J. Horan
Lead Engineer, Commercial Technology
Air Products and Chemicals, Inc.

Problems associated with failing regenerators can be time consuming and labor intensive. But, the issue can be solved by supplementing or replacing the ailing combustion system with oxygen lancing and/or ThruPort burners. In this article, Air Products shows us how.

It is well known that the progressive failure of regenerator checker packs that frequently occurs in ageing glass furnaces causes a gradual restriction of combustion air and flue gas flow passages. This fouling process, if left unabated, can ultimately lead to a significant reduction in pull rate while also lowering energy efficiency during glass melting. Moreover, even when compartmentalized checkers are employed and hot repairs can be carried out, these are very time consuming and labour intensive processes that may require extended furnace downtime or, at best, extended periods of reduced pull, sometimes up to several weeks or more. Recognizing the need that thereby emerges for a substantial amount of high-temperature and on-the-fly fire-power, often on an emergency basis, Air Products has developed the Cleanfire® ThruPort™ oxy-fuel burner to debottleneck production for furnaces that are constrained by crippled regenerators. To illustrate their use and effectiveness, this paper presents and describes two

recently-executed projects using the ThruPort burner on regenerative air-fired float glass furnaces. One furnace, equipped with compartmentalized checkers, used three ThruPort burners during a one-month period over which checker repairs were made. The second furnace, which did not employ compartmentalized checkers, used two ThruPort burners to maintain full production for the final seven months of the furnace campaign. Details presented herein include burner design, installation and operation, oxygen supply and melter performance.

INTRODUCTION

As improvements are made regarding refractory, maintenance and operation of glass furnaces, the expected campaign length has increased and in some cases nearly doubled in the last 20 to 25 years. As the life of the melter has improved, the regenerators and checker packs that used to operate for as many as two campaigns now struggle to last one. This is especially true in the float glass industry, where campaigns are approaching 18 to 20 years. This paper describes the experience of two float glass furnaces at different points in their furnace campaigns, both having similar issues with premature failure of the checker packs inside the regenerators.

One solution is to use oxy-fuel combustion to supplement air-fuel combustion over all or part of the furnace. This paper summarizes the field installation, start-up and operation of an oxygen supplemented combustion system. Safety considerations were carried out through training of plant personnel on oxygen safety. Potential solutions involve combinations of several air-fuel and oxy-fuel options:

- Oxygen enrichment of the combustion air
  - Usually not more than 26%
- Oxy-boost burners
  - Limited by their location in the furnace
- Oxygen lancing
  - Limited by the amount of air available and the achievable mixing rate in the port and furnace
- Cleanfire ThruPort oxy-fuel burners
  - Considered the best solution short of a full conversion to oxy-fuel
  - No combustion air required

The features of the ThruPort burner (Figure 1) include:

- Firing rate: 4 to 20 MMBTU/hr
- Fuel: natural gas or oil
- Water-cooled jacket
- Oxygen staging
- Bright and luminous flame
- Adjustable flame length and trajectory
- Optional on-line sensors

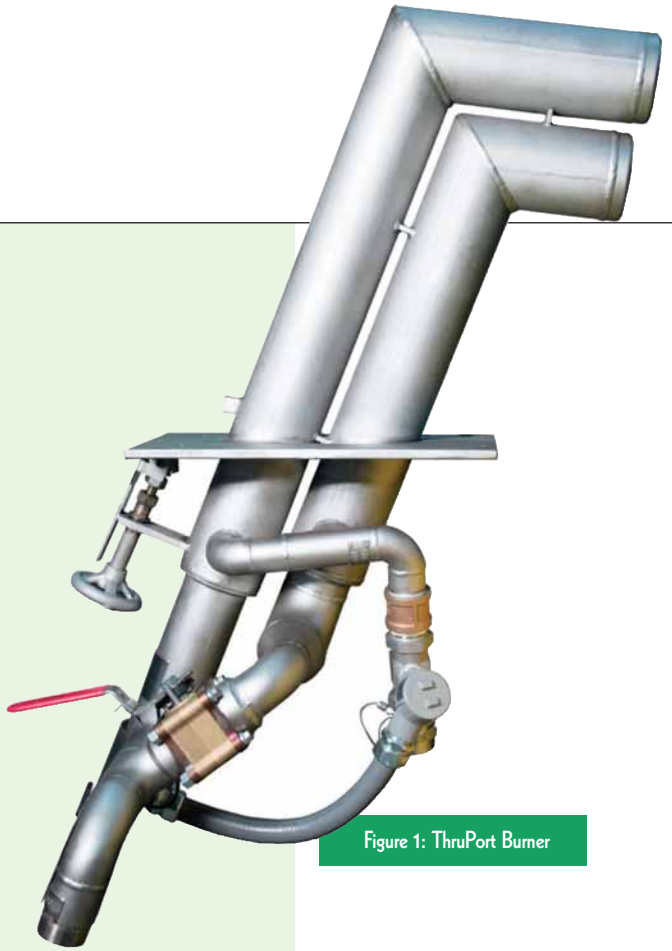


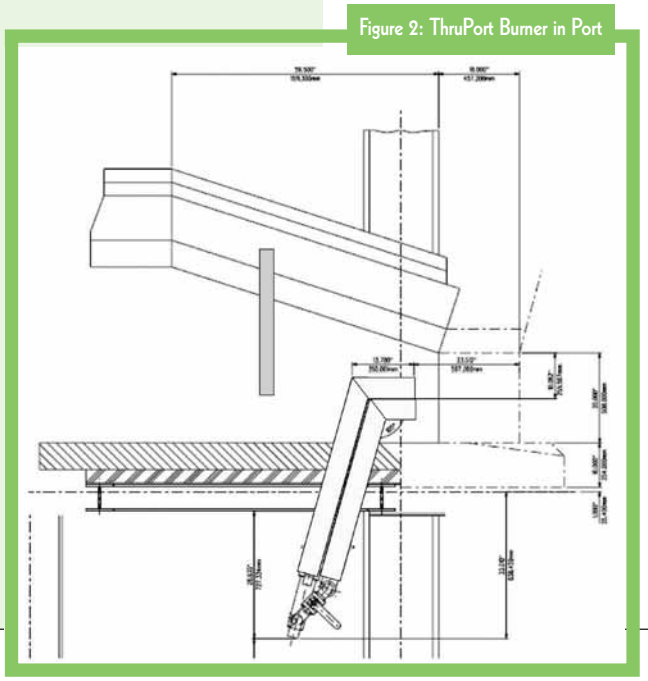
Figure 1: ThruPort Burner

- Rapid deployment

The ThruPort burner allows for on-the-fly installation through the bottom of the port. This burner allows production to continue without interruption during the installation and is ideal for use during hot checker repairs or to extend the life of the furnace when combustion air is severely restricted. Figure 2 shows a side view of a typical installation of the burner in a port.

This burner has oxygen staging, which diverts oxygen from the main burner through a second port directly below the flame. The

Figure 2: ThruPort Burner in Port



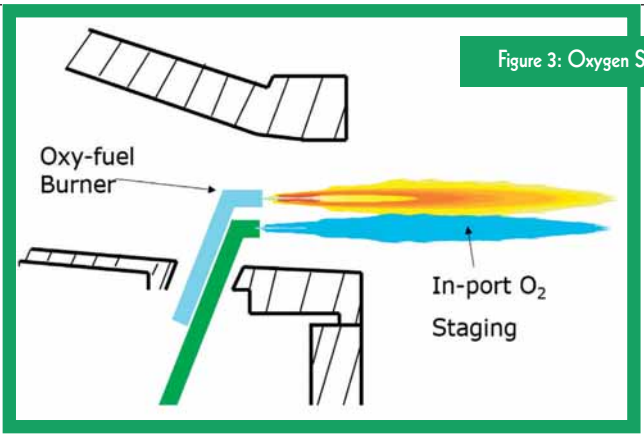


Figure 3: Oxygen Staging

staging of oxygen creates a soot-rich reducing flame, which increases luminosity, lowers the peak flame temperature, and directs the heat flux into the glass. By adjusting the amount of staging, you can tailor the flame shape and length. The reduced maximum flame temperature decreases the production of NOx, while the top soot layer of the flame reflects heat away from the crown and into the glass. The burner can be adjusted up or down in proximity to the glass surface. Figures 3 and 4 highlight the use of staging and the effect of the tilt adjustment.

FIELD INSTALLATIONS - TWO PLANTS WITH SIMILAR CHALLENGES

Plant 1 - Background

The first float glass plant was aware of the deterioration of the checker pack for about a year. The furnace is a six-port gas-fired regenerative melter with one common regenerator chamber on each side of the furnace. This furnace was near the end of its campaign and had less than one year left until its scheduled rebuild date. The initial conditions reported by the plant indicated that the checker pack on the right side of the furnace had collapsed and the lancing system installed on the first four ports was no longer capable of supplementing the combustion air adequately to allow sufficient combustion to support the desired pull on the furnace. The furnace pull rate had been reduced by 50 t/d in order to produce glass of acceptable quality. In addition, three by-pass flues were installed on the right regenerator to allow combustion air to reach the top of the regenerator. The checker pack on the left side of the furnace had not deteriorated to the point where it had impacted combustion. The furnace had been using four oxy-fuel boost burners for several years, one pair between the charge end wall and the #1 port and a second pair located at what would be considered the #7 port. The lancing system had been installed and operating for two months on the first four ports. With lancing, the furnace pull rate, temperatures and emissions were maintained until further deterioration of the checkers made it impossible to keep temperatures and production at desired levels. At this point the decision was made to install ThruPort burners to keep the furnace running and extend its life until the planned rebuild.

Discussion

The two ThruPort burners would be installed, one on each side of the furnace at the #4 port. The objective was to install these burners and determine if furnace conditions could be stabilized and then see if additional pull could be added. The following were identified as key resources that would be utilized to support this project:

- Sources of Oxygen
  - On-site VSA oxygen generator
  - On-site liquid oxygen (LOX) storage tank
  - Truck delivery of LOX from local merchant gas production plant

Figure 4: Effect of Staging and Tilt Angle

- Vaporizer capacity
  - Existing vaporizers (four) would not be sufficient
- Control Distribution Skids
  - Two oxy-fuel skids
  - One oxygen skid
- Three ThruPort oxy-fuel burners with lift mechanism
- Cooling water supply and return lines
- Oxy-fuel boost burners between the charge end wall (CEW) and #1 port, and in the #7 port position
  - Maximize the heat input from these burners
- Safety training on oxygen for plant personnel and operational training on the ThruPort burner for furnace personnel
- Computational fluid dynamics (CFD) modeling

It was determined that due to the volume of oxygen required, APEX Express Service units would be used to provide additional on-site oxygen storage and vaporizing capacity. These units consisted of four portable trailers, two for LOX storage and two with dual vaporizer banks. Figure 5 below is a picture of the APEX units.

Table 1

	Units	Baseline	Fouled Regenerators	ThruPort
Pull Rate	TPD	650	600	650
Fuel Firing Rate	mmBTU/hr	163.0	149.9	147.1
Air Flow Rate	scfh	1,681,100	1,512,990	985,000
Air Preheat	Deg C	1250	1000	1000
Glass Temp	Deg C	1296	1270	1286
Flue Gas Temp	Deg C	1501	1476	1321
Energy Consumption	mmBTU/ton	6.02	6.48	5.43

Figure 5: Typical APEX Units

CFD modelling

To verify the fuel and energy savings seen at Plant #1, a CFD modelling study was conducted. The results of that model are summarized in Table 1. The baseline case was conducted at full pull rate prior to oxygen lancing, with regenerators operating as expected and two of the four boost burners. The fouled regenerator case was at a reduced pull rate, no lancing and four boost burners. The last case is the furnace operating at full pull rate, two ThruPort burners, lancing on three ports and two boost burners. The energy savings produced with the installation of two ThruPort burners and three ports of oxygen lancing show a 9.8 per cent

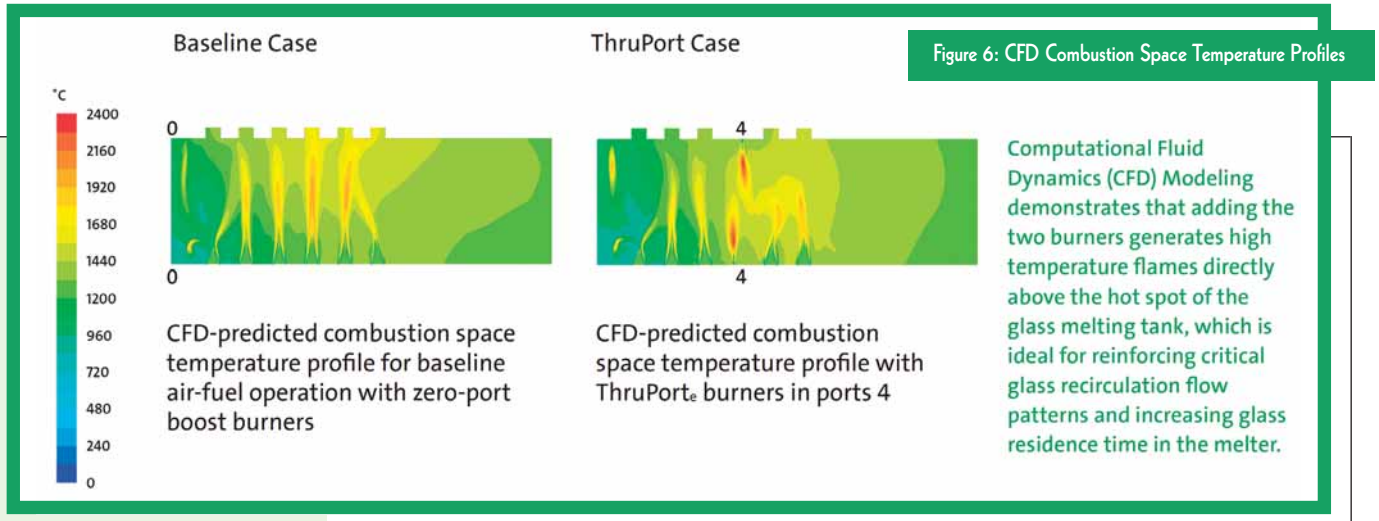


Figure 6: CFD Combustion Space Temperature Profiles

reduction, similar to what was seen in the field and similar to the fuel savings observed at other installations. Figure 6 shows the combustion space temperature profile predicted by the CFD model, with zero port boost burners and normal air fuel firing on all six ports on the left. On the right is the temperature profile predicted with ThruPort burners in the #4 port and zero port boost burners.

Preparations prior to the installation of the ThruPort burners included port modifications, such as cutting a hole in the port bottom grating and saw cutting a similar hole in the port bottom refractory. The cooling water supply and return lines, and the oxygen and natural gas tie-in points were identified, and appropriate flex hoses and fittings obtained. The logistics of the lift mechanism and how it would be positioned between and under the port was determined. Finally, training was conducted with regard to oxygen safety, as well as installation and operation of the ThruPort burner. Figure 7 is a picture of a mock installation conducted in one of Air Products' combustion laboratory furnaces. Figure 8 is a picture showing the burner installed in the #4 port prior to the back of the port being blocked off.

Once all three combustion systems were operating, adjustments were made to the fuel, oxygen and air flows to optimize furnace operation. The first adjustments increased firing on the air fuel ports and supplemental oxygen lancing as needed. The boost burners and oxy-fuel ThruPort burners were then adjusted. Each adjustment would be made after reviewing excess oxygen levels, temperatures, glass quality and emission levels on the furnace. Since the energy input into the furnace was being supplied by three distinct and different combustion systems, it was understood that it would take some time to optimize the firing rates of each system.

Results

- Two ThruPort burners installed in the #4 port left and right
- Temperature profile on the furnace was re-established
- Pull increased to target level of 650 t/d
- NOx emissions below permit operating limits
- Glass quality back to normal levels
- Furnace life extended seven months to match planned rebuild date
- Close agreement between CFD modeling and results achieved - 9.8% vs 9.7%

Figure 7: ThruPort Mock Installation

Figure 8: ThruPort Burner Installed

Plant #2 - Background

Similar to Plant #1, this float glass plant also had failing checkers. The plant had been aware of the deterioration of the checker pack in both regenerators for about a year. The furnace is a six-port gas-fired regenerative melter. The furnace has compartmentalized checkers and was in the eighth year of an expected 16-year campaign. The checkers in the fifth port had collapsed and were plugged to the point where it became necessary to partially remove the division wall between the fifth and sixth ports to allow combustion air and exhaust gases to enter and exit this area of the furnace through multiple paths. At one point, the checker pack in the fourth port right side had started to collapse and was now an added concern. The furnace was pulling ~650 t/d and had acceptable glass quality and melting conditions. The combustion air blower was at or near maximum output, and air flow had been reduced to the first three ports and was being redistributed down tank. CO levels were elevated across all ports, and excess oxygen in the exhaust was at a minimum. NOx levels were near maximum, but below permit limits. Between the charge end of the melter and the first port, a set of Cleanfire® HR_i™ advanced boost burners had previously been installed and had been operating successfully for the last several years. Up to this point, the plant was able to counteract the decrease in combustion air by changing the firing profile of the melter and increasing fuel and air to adjacent ports.

Phase I: Oxygen lancing Discussion

As conditions deteriorated, it was decided to investigate options for improving the furnace combustion and thereby delay the decision to idle the furnace and perform a hot checker repair. It was at this point the plant contacted Air Products, their gas supplier, to discuss potential solutions. Multiple options were identified, including oxygen enrichment, oxygen lancing and ThruPort burners. Based upon conditions of the furnace at the time, it was decided to eliminate oxygen enrichment as an option due to the extent of enrichment that would be required. Based on the current condition of the furnace and regenerators, it was decided to use oxygen lancing to supplement the lack of combustion air. Initially one oxygen lance was installed in each side of the #4 and #5 ports under the main natural gas burner. The goal was to increase the excess oxygen as measured in the exhaust port, reduce the CO levels, and hold or reduce current NOx levels while maintaining temperature and pull. The first step in the process was to identify all available resources and define the scope of work required.

The key resources utilized:

Sources of oxygen

- On-site VSA oxygen generator
  - On-site LOX storage tank
  - Determine logistics for delivery of 25 t/d of additional LOX
- Oxy-fuel boost burners between the CEW and #1 port

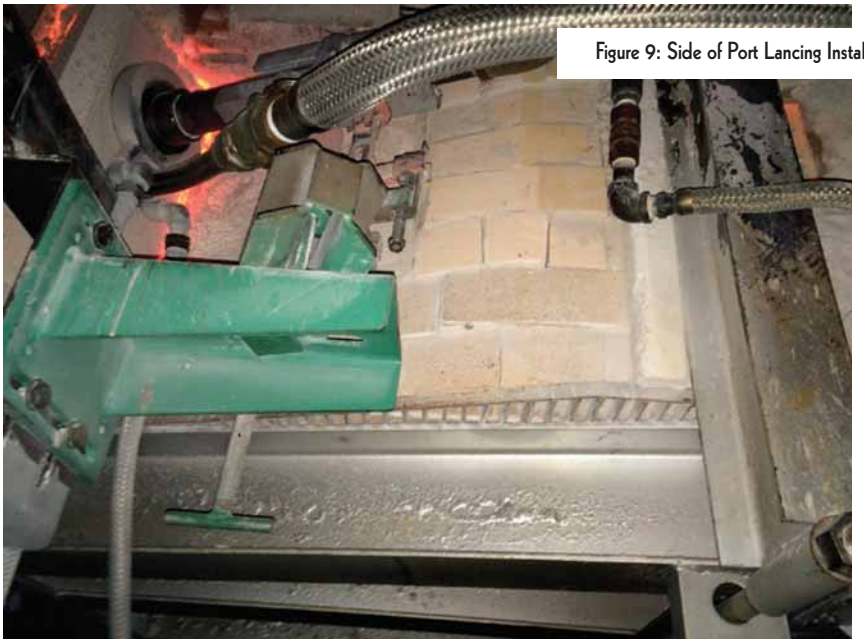


Figure 9: Side of Port Lancing Installation

Table 2

Port #	Initial Fuel Flow (scfh)	Final Fuel Flow (scfh)
1	29,615	28,570
2	29,750	29,700
3	27,425	21,190
4	28,395	21,720
5	26,055	26,010
6	9,015	9,000
Total	**150,010**	**136,190**

  - Maximize the heat input from these burners
- Distribution and control skid
  - Fabricate new vs. used
- Turnkey project requested by the customer
  - Supply engineering and design
  - Prepare bid package and select mechanical contractor with customer approval
  - Confirm vaporizer capacity was adequate

Oxygen lancing was first installed on the #4 and #5 ports on both sides of the furnace. Eventually, lancing was extended to the #3 port left and right as well. Exhaust gas readings were analyzed for excess O2, CO, and NOx before and after the lancing system was installed on each port. Eventually, combustion air was reduced to bring NOx levels back to original levels. The results of Phase I are listed below along with Figure 9, which shows the side of port lancing system in place.

- Successfully provided oxygen lancing to ports 3, 4 and 5 for approximately one year
- Maintained melter temperatures and profile
- Maintained furnace pull
- Emissions kept below permit limits
- Due to limitations on control of O2/fuel mixing, the point of diminishing returns on O2 lancing effectiveness was eventually reached.

Phase II: ThruPort oxy-fuel burners

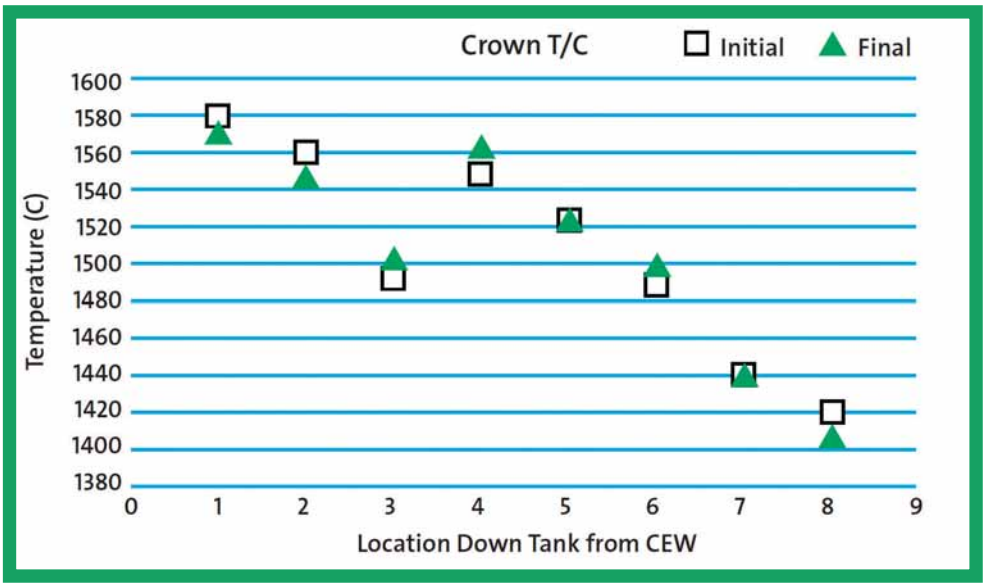
Discussion

After one year of increased checker deterioration and collapse, it became clear that the lancing option would not be sustainable for the balance of the furnace campaign. The decision was made to replace the checker packs behind the worst four ports of the melter. To perform this hot checker repair and maintain full production, it was necessary to install ThruPort burners in the affected ports. The most air-starved ports were #3 and #5 right and #4 and #5 left.

It was decided that one regenerator compartment on each side of the furnace would be replaced simultaneously with an expected duration of two weeks for complete demolition and replacement of the checkers. Once completed, the burners would be removed from the repaired ports and moved to the next set of ports to be repaired. The total planned repair would therefore take approximately one month to complete. Given this time line, it was necessary to provide an uninterrupted supply of oxygen.

The first two checker packs to be replaced were #3 right and #4 left. Table 2 shows the furnace fuel distribution prior to and after the installation of the ThruPort burners. The total fuel reduction was approximately 10 per cent, due primarily to the efficiency of the oxy-fuel burners. Figures 10 and 11 show the before and after temperatures of the crown and bottom thermocouples. As indicated, the furnace temperatures remained basically unchanged during the repair period, as did the furnace pull rate, glass quality and emissions. Throughout the repair, the vaporizers were continuously monitored and de-iced as needed to ensure a constant flow of oxygen was delivered to the furnace. As each checker pack was replaced, the port was opened and gradually

Figure 10: Before and After Crown Temperatures



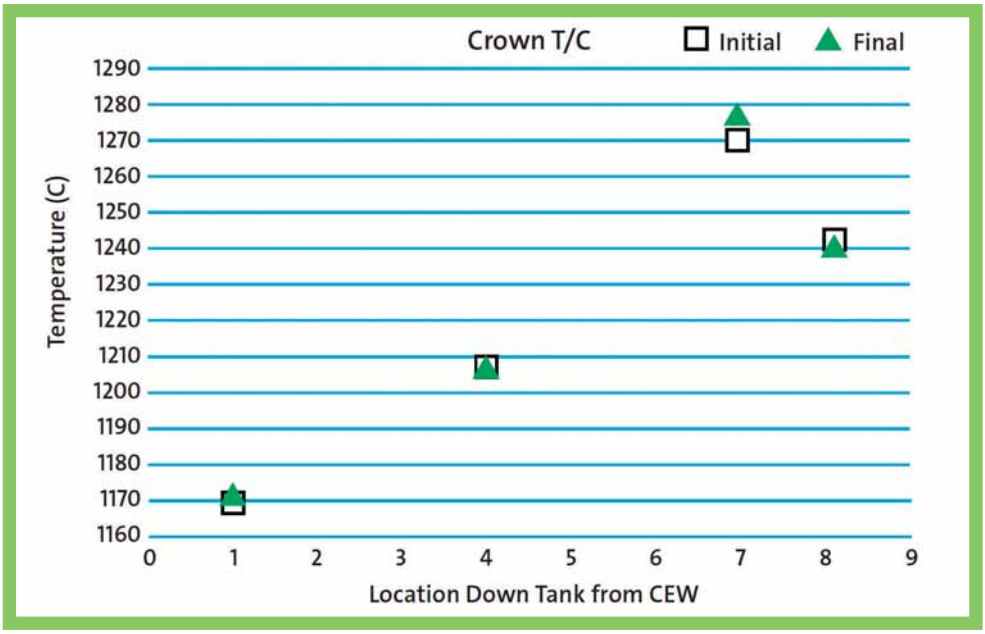


Figure 11: Before and After Bottom Temperatures

converted back to air-fuel firing.

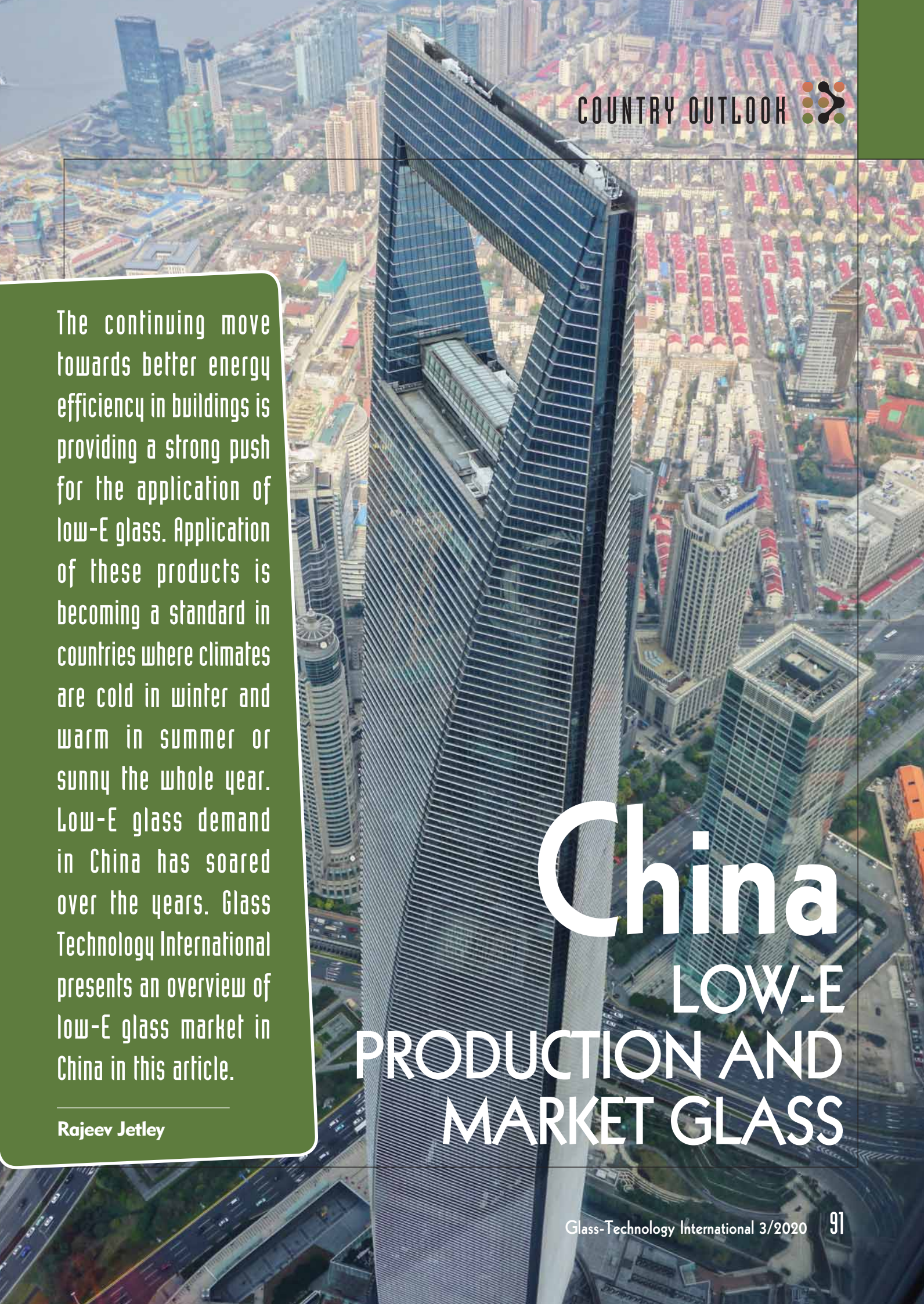
A variety of challenges associated with the layout and operation of the furnace were encountered and addressed. First, the burner could not be centered in the bottom of the port due to the layout of the port support steel. This issue was overcome by the ability of the burner to be adjusted upstream or downstream in the port. Another challenge was the fact that the burners were operated directly across from an air-fired port, and the back of the port could not be blocked off for several days. These conditions were overcome by the flexibility of the burner's oxygen staging feature.

Phase II resulted in:

- Successful installation of one set of ThruPort oxy-fuel burners in two sets of ports for a one-month period while checker packs were replaced
- Maintaining melter temperatures and temperature profile
- Maintaining furnace pull
- NOx emissions kept below permit limits

SUMMARY

The problems associated with failing regenerators, whether it be the need for a hot checker repair or to maintain furnace production and extend the life of the furnace, can be solved by supplementing or replacing the ailing combustion system with oxygen lancing and/or ThruPort burners. The infrastructure to support these systems is available and can be rapidly deployed. Once installed, these solutions can offer the ability to maintain production and glass quality, reduce fuel consumption, and extend the life of the furnace.



China

LOW-E PRODUCTION AND MARKET GLASS

The continuing move towards better energy efficiency in buildings is providing a strong push for the application of low-E glass. Application of these products is becoming a standard in countries where climates are cold in winter and warm in summer or sunny the whole year. Low-E glass demand in China has soared over the years. Glass Technology International presents an overview of low-E glass market in China in this article.

Rajeev Jetley

THE CHINESE LOW E GLASS MARKET

Accounting for more than 50 per cent of the global flat glass output, China is the largest flat glass producer in the world by a wide margin. The use of value added glass products has increased by huge amounts in the country in the last few years. Low-E glass types, which are among the most important product categories of value added glass, have seen significant developments and investments made by Chinese flat glass producers in these years.

The production volume of coated glass in the architectural glass industry in China increased from 235 million square meters in 2014 to 293 million square meters in 2018, at a CAGR of 5.7 per cent. With the released mandatory energy-efficient standards for buildings becoming stricter, the demand for coated glass maintains a moderate rate. The growth of coated glass is expected to continue in the coming years, driven by increased market demand for the development of commercial buildings and high-end residential construction towards energy efficiency and a certain degree of privacy.

According to the Guidance Opinion and expert opinions of China Architectural and Industrial Glass Association (CAIGA) and industry players, coated glass production volume and sales volume in the PRC is expected to increase from 293 million square meters and 249 million square meters in 2018 to 427 million square meters and 373 million square meters in 2023, at a CAGR of 7.8 per cent and 10.6 per cent, respectively.

Low-E glass accounted for the largest market share of 63 per cent in 2018 by production volume in the coated glass market. China's low-E glass production volume increased from 139 million square meters in 2014 to 185 million square meters in 2018, at a CAGR of 7.4 per cent. The production volume of low-E glass is expected to increase continuously and rapidly, driven by the rising market recognition and wider application of low-E glass in public buildings and commercial buildings. Low-E glass production volumes are expected to increase from 185 million square meters in 2018 to 272 million square meters in 2023, at a CAGR of 8 per cent, according to experts from CAIGA. The sales volume of low-E glass in the architectural glass industry increased from 120 million square meters in 2014 to 164 million square meters in 2018, at a CAGR of 8.1 per cent, and is expected to increase from 164 million square meters in 2018 to 247 million square meters in 2023, at a CAGR of 8.5 per cent.

Low-E glass (low-emissivity glass) is a coating product which is made by coating various layers of

metal or other compounds onto the glass surface. It has high transmittance to visible light and high reflection to medium/long wave infrared. Compared with ordinary glass, it has excellent thermal-insulation performance and good visible-light transmittance. It is divided into single-silver, double-silver and triple-silver products based on the number of layers, and can be subdivided into various special functional products such as heat preservation, shading, anti-glare and temperable glass.

The triple-glazed insulated portion of the low-E glass market has grown rapidly in recent years, replacing double-glazed products and increasing the amount of low-E glass needed to make the same amount of final product. This trend to continue, further boosting demand for low-E glass in China.

HUGE POTENTIAL FOR GROWTH IN LOW-E GLASS CONSUMPTION IN CHINA

The upgrading of existing buildings in the country offers a huge opportunity for the coated flat glass market, mainly for low-E glass, which has insulating and solar control properties, to increase energy efficiency.

In recent years, the Chinese government has made a number of efforts to promote green building. According to the Action Plan of Promoting Production and Application of Green Building Material jointly issued by the Ministry of Industry and Information Technology and the Ministry of Housing and Urban-Rural Development, the ratio of green building material applied will increase significantly, and its quality will also improve. The proportion of green building material will take up 30 per cent in new buildings, 50 per cent in green buildings, 70 per cent in pilot projects, and 80 per cent in renovating existing buildings. High-end energy saving glass will be an important part in green buildings. Introduction of a new urbanization strategy, Beijing-Tianjin-Hebei integration, Greater Bay District, and the integration of the Yangtze River Delta was upgraded to a national strategy, which will bring new opportunities to low e glass suppliers.

The construction and renovation of energy-saving buildings will promote the development of coated glass and the low-E glass market. In 2018, China's urban and rural construction area was about 60 billion square meters, of which more than 90 per cent were energy-consuming buildings. Reducing the energy consumption of new buildings and existing buildings is an important part of the current energy conservation policy. At present, several finance bureaus at local provincial level have implemented special budgetary funds for energy conservation, while other green building economic incentive policies such as loan interest rate concessions and floor area ratio awards have also been introduced. Coated glass, especially low-E glass, is an important building material for energy-saving buildings and will have an important space for market growth.

Recent results of construction completions have been a good news for low-E glass suppliers in China. After a slowdown in November 2019, new starts and completions picked up again in December 2019. New property completions

reported a year-on-year growth of 20.2 per cent in December 2019, compared to a year-on-year increase of 1.8 per cent in November 2019 and 19.2 per cent in October 2019, as well as a decline of 5.5 per cent in January-October 2019. New starts in terms of floor area reported year-on-year growth of 7.4 per cent in December 2019, -2.9 per cent in November 2019, 23.2 per cent in October and 10.0 per cent in January-October 2019.

Float glass prices in China have remained stable (at over CNY 81/DWC in Dec 2019) due to more favourable demand/supply dynamics. The average float glass price in key cities in China was CNY 81.7/weight case in 4Q19, an increase of 0.7 per cent from an average of CNY 81.1/weight case in the third quarter of 2019, 7.0 per cent from an average of CNY 76.3/weight case in the second quarter of 2019, and 7.9 per cent from an average of CNY 75.7/weight case in the first quarter of 2019. The average float glass price dropped below CNY 81/weight case on 17 January 2020.

LOW-E GLASS MANUFACTURERS IN CHINA

China has a huge number of low-E glass producers. However, due to space constraints, this article will present an overview of just a few leading low-E glass manufacturers.

XINYI GLASS

Xinyi Glass (XYG) is one of the largest producers of low-E glass in China. Besides low-E glass, the company also produces and distributes flat glass and auto glass. It is the largest auto glass exporter in China in the after-market sector (20 per cent of global market share). XYG has a 29.5 per cent stake in Xinyi Solar Holdings, which is the largest solar-glass manufacturer in China.

Xinyi Glass has supplied low-E glass products for landmark buildings in large- and medium-sized cities in China and other countries and regions, such as the Shanghai World Expo China Pavilion, Shenzhen Universiade Center, Hong Kong-Zhuhai-Macao Bridge, Nanning Wuxu

International Airport, Malaysia Four Seasons Hotel, Singapore DUO.

TAIWAN GLASS

Taiwan glass, one of the largest float and value added glass manufacturers in Taiwan and mainland China, is one of the leading manufacturers of low-E glass. The company operates a total of five low-E production lines in mainland China and Taiwan.

In mainland China, Taibo Changjiang Glass Company and TG Chengdu produce low-E glass products. Located in the Kunshan of China's Jiangsu Province, Taibo Changjiang Glass Co., Ltd. (CFG) has three low-E glass production lines with an annual output of 10 million square meters of different types of low-E glasses. TG Chengdu (Qingbai River Industrial Area, Chengdu) Glass operates a high-end low-E glass production line with an annual capacity of 8 million square meters per annum.

In Taiwan, the company produces low-E glass at its Taichung production facility.

CSG HOLDING

CSG has five architectural and low-E glass processing centres which are located in Tianjin, Dongguan, Xianning, Wujiang and Chengdu. The company possesses the international advanced glass deep-processing equipment and testing instruments, and its products cover all kinds of architectural glass. The company's R&D and use of coating technology keep pace with the world and its technology of high-end products are even top global level. Following the second generation of energy-saving glass products, the company has successively developed the third generation and multi-function energy-saving glass products with continuous improvements in energy-saving and heat-preservation effects. At present, the company's low-E coated glass and low-E coated insulating glass have reached ab annual capacity of more than 36 million square meters and 16 million square meters respectively.

KIBING GLASS

Founded in 1988 and listed on the Shanghai Stock Exchange, Kibing Group is among the leading manufacturers of low-E and float glass in China and the South East Asian region. With total assets of more than CNY 12.8 billion and more than 6,000 employees, the company offers a wide range of glass products, services and architecture solutions, high graded float glass, green energy-saving eco glass, photovoltaic solar energy glazing and extra-thin electronic glass, etc. The company has a total of eight production bases with 25 float glass lines located in China and Malaysia.

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COMPANY DATA

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Sales
Domestic 5% / International 95%

Area
Office area 500 m² / Plant area 3,500 m²

Number of Employees
42

Founding Year
1978

Capital
EUR 90,000.00

Planned Exhibitions
Seebe - Belgrade, Serbia - 22 / 25 April 2020
Glass TEXpo - San Antonio (TX), USA - 01 / 02 May 2020
Glass South America - Sao Paulo, Brazil - 3 / 6 June 2020
Mir Stekla - Moscow, Russia - 8 / 11 June 2020
Glasstech Mexico - Guadalajara, Mexico 27 / 29 July 2020
GlassBuild America - Las Vegas (NV), USA 15 / 17 September 2020
Glasstec - Düsseldorf, Germany - 20 / 23 October 2020

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solutions for glass washing. We offer a full range of high-t
vertical washing machines that are easy to use and main

AUTOMATION AND ROBOTICS SOLUTIONS (CYBERAL)
We are constantly formulating solutions to operate at the hi-ghest levels of automation, making the most of integration with robotics to increase pro-ductivity and reduce costs.

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Do you have special needs? Out-of-standard processes? Do

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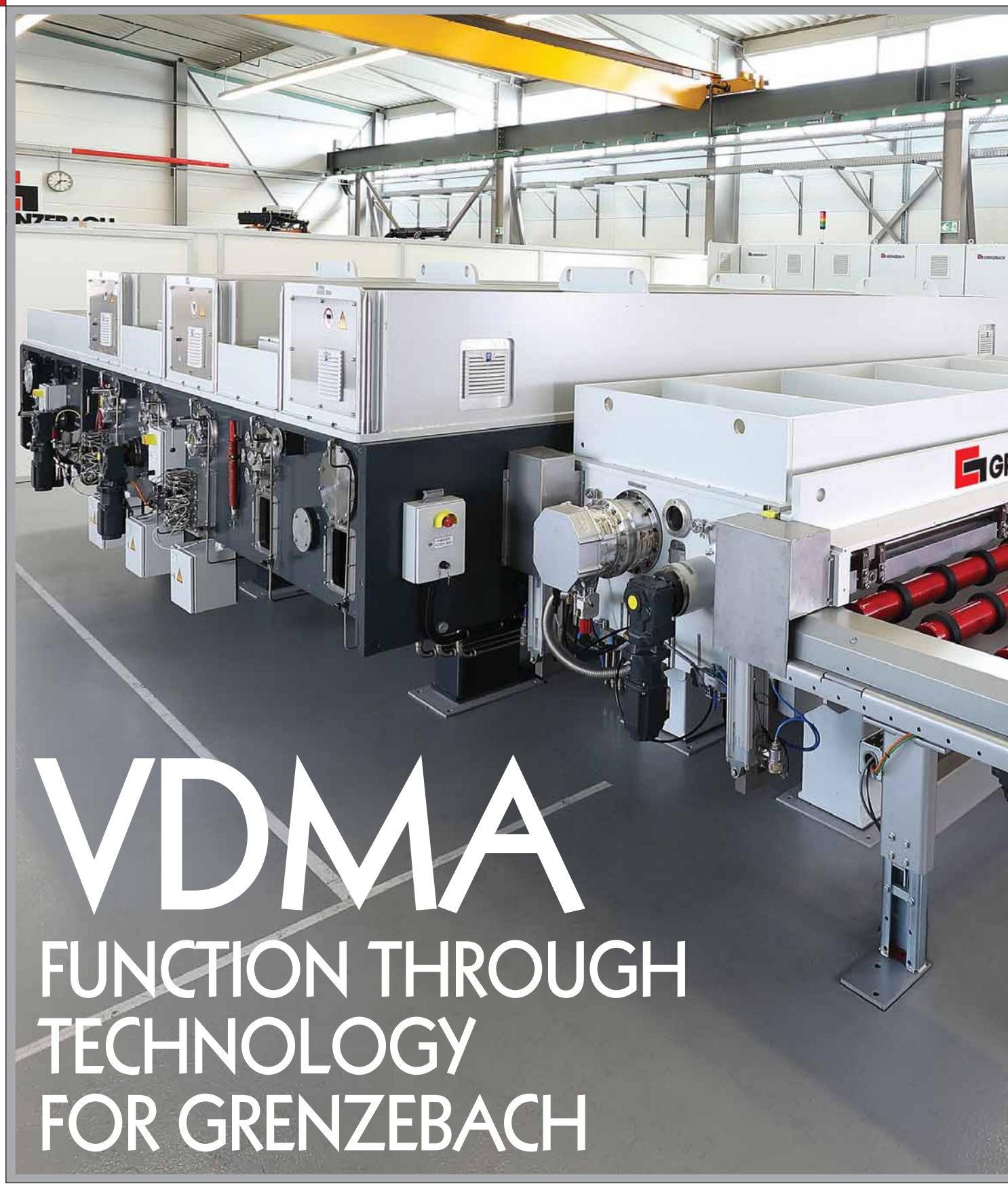

VDMA FUNCTION THROUGH TECHNOLOGY FOR GRENZEBACH

Multifunctional glass has a fascinating range of uses, yet is challenging to produce. Modern architecture and some industrial sectors today are unimaginable without it. Coatings and textures allow the glass to fulfil multiple functions simultaneously, but these demand additional steps in production. New technologies are helping to shorten processes and increase productivity.

The core challenge in producing thermal insulation coatings is the size of the substrate to be processed, combined with the need to maximise the system service life and reduce maintenance times. Grenzebach Maschinenbau GmbH has now opened a coatings laboratory to develop solutions for the panes, which can be up to 3.4 metres in width. Coatings can be applied for high-end products, from dielectrics such as silicon nitride and titanium dioxide to ultra-thin metal and blocker layers like silver and nickel chromium, and even transparent conductive layers for use in the display and solar industries. Tests in this laboratory can answer a variety of questions, such as how to apply silver layers to thermal insulation glass while also extending the service life of the system.

Digital support

In order to minimise shutdown and maintenance times, digital solutions support the production process. The IIoT platform SERICY developed by Grenzebach controls all the processes of coaters and peripherals in production, the warehouse and shipping. The data collected can be used to derive continuous analyses and adap-

tations, which further optimise performance and thus economy. App-supported assistance systems help in this task.

Automated PVD coating lines

The aim of all this is to offer almost fully automated PVD coating lines. The PVD process is a vacuum-supported procedure for layer removal. The sputter process has a significant effect on layer growth, with the involvement of excited atoms and molecules and/or ions generated in plasmas. This allows manufacturers to produce all coatings on large surfaces, from sun protection applications to high-quality thermal insulation glasses (low-E layer systems).

Recent installation

Grenzebach recently installed a system for an American manufacturer that produces more than 500 kilometres of sheet glass worldwide every day, demonstrating just what this procedure is capable of. The glass is intended to ensure a pleasant temperature and high energy efficiency in buildings. The production line can coat more than 12 million square metres of sheet glass with thermal insulation or sun protection coatings every year. The processing section of the coating system is equipped with eleven process chambers and a range of coating stations, which apply various coating systems to the glass in a precisely defined order. Two of Grenzebach's three stackers work constantly to add new sheets of glass and remove them at the end of the production line. As the product is sensitive to touch both before and after coating, the stackers are arranged in such a way that they pick up the coated sheets from underneath. Stacking, coating and unstacking on racks: the entire line covers 9,300 square metres, or the size of 1.3 football pitches. 110 metres of the coating system is under vacuum, while the section equipped with conveyor technology measures 450 metres in length.

NO AUTOCLAVE REQUIRED

Laminated glasses undergo a complex process. They generally consist of three layers: a glass layer at the top and bottom, enclosing a layer of PVB, SGP or EVA film, for example. An autoclave is used in the standard process, but this is complex and cost-intensive. Robert Bürkle GmbH has developed inline flat lamination – a new multi-stage process that can be used for laminated glass or laminated safety glass, and even switchable glass. Lamination is faster and is flexible in terms of glass structure. Moreover, set-up times are short when switching between different products.
The glasses enter the laminator in batches. As the batches are only formed on the feed belt, the process enables a high level of flexibility. A vacuum removes the air between the layers before lamination, which then begins with a vacuum flat press heated on both sides. Steel plates heated with thermal oil ensure symmetrical and homogeneous temperature input across the entire surface. Simple glasses such as tempered glass can be processed at a temperature of around 150°C. The effective area is 2,600 millimetres by 5,000 millimetres and the cycle time is less than 10 minutes. Lamination of particularly thick glasses can be completed in a second step, thereby reducing the cycle time. Another flat press then cools the laminated glasses and completes the process.
This procedure allows fast and even lamination without overpressure at the edges, which is a particular problem in membrane laminators. Cooling both sides simultaneously under pressure prevents internal tension and deformation. These flat presses are suitable for safety glass, decorative glass, solar modules, and especially multifunctional glasses that are to be equipped with sensor technology or contain functional films.

BRIGHT AND WARM

Windows and fully glazed tower façades today do a lot more than just letting light into the building. Numerous functional layers meet the requirements of modern working environments and personal preferences. Electrically conductive layers are in just as high demand as self-cleaning surfaces and thermal insulation. Glass that both lets light in and keeps heat inside the building demands a special metallic coating. Manz AG worked with Trumpf GmbH + Co. KG to develop a laser process that makes this surface treatment more efficient for a French glass manufacturer.

Improving thermal insulation properties

The goal was to improve the thermal insulation properties of very large glass substrates while also allowing the greatest possible quantity of light to permeate. Manz has many years of expertise in producing thin-film solar modules. The company was therefore responsible for the conveyor line with consistent synchronisation, the high-precision kinematic control of the laser optics including all sensor technology and inline measurement technology, and the overall integration of all individual components to form a system ready for production. The glass manufacturer integrated this into its production flow, downstream of the inline coating system.

Line optics and laser sources

Eight line optics arranged next to each other make it possible to process the glass sheet running underneath at a width of 3.30 metres. Twelve laser sources with 12 kW of power each feed into the line optics, which Manz has constructed as a bridge across the width of the conveyor line. A continuous laser line across the entire width of the glass sheet requires precise control. The Gaussian width and edge characteristics at each end of the line must be ensured. Homogeneous energy input within the individual lines and the correct focus depth were further requirements for the quality of the products. With a width of less than 100 μm, the laser line only briefly heats a silver coating that is just a few micrometres thick on the glass substrate. The coating thus switches from an amorphous to a crystalline state, thereby enhancing the insulation effect and transparency of the material. The more constantly the glass substrate, which can weigh up to 750 kilos, is transported along the line and the more constantly the laser inputs the energy, the higher the quality of the coating. In order to adapt the system to various products quickly, flexibly and based on the recipe, the line optics are mounted on very stiff, moveable fixtures to ensure the highest level of precision. Cooling units and radiation protection equipment provide the necessary safety.

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The VDMA represents around 3,300 companies in the medium-sized mechanical and plant engineering sector. With a good 1.3 million employees in Germany and a turnover of EUR 230 billion (2019), the industry is the largest industrial employer and one of the leading German industrial sectors overall.

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Fenzi
Forel
Lisec Group
Schiavo
Tecno Glass
Tenon (Beijing) Equipment
Triulzi

GAS FILLING EQUIPMENT
Bystronic glass
Fenzi
Forel
Lisec Group
Neptun
Schiavo
Sparklike
S.T. Group
Tecno Glass
Tenon (Beijing) Equipment
Thermoseal Group

DESICCANT SALTS
Ashton Industrial Sales
Fenzi
Neptun
Schiavo
S.T. Group
Tecno Glass
Thermoseal Group

SPACERS/PROFILES
Ashton Industrial Sales
Edgetech Europe
Fenzi
Schiavo
S.T. Group
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Thermoseal Group

GEORGIAN BARS
Ashton Industrial Sales
Hegla
Tecno Glass
Thermoseal Group

BUTYL
Ashton Industrial Sales
Fenzi
Thermoseal Group

POLYSULPHIDE SEALANTS
Fenzi

HOT MELT
Ashton Industrial Sales
Fenzi
Thermoseal Group

OTHER SEALANTS
Fenzi

PANTOGRAPHS
Fratelli Pezza

ACCESSORIES
Ashton Industrial Sales
Deltamax Automazione
Diamant - AR Nunziata
Dieffe Macchine
Forel
Forza G / G. Tech
Helios Quartz
Schiavo
Sparklike
S.T. Group
Tenon (Beijing) Equipment
Triulzi

Tempering

TEMPERING FURNACES (ARCHITECTURAL GLASS)
CNUD-EFCO
Glaston
Glass Company
Glasstech Inc.
Hornos Industriales Pujol
Keraglass
Landglass Technology
Lema
Lisec Group
Mappi International
Schiavo
Shanghai North Glass Technology
Tekno Kilns
Satinal - Strato - TK

TEMPERING FURNACES (AUTOMOTIVE GLASS)
Glaston
Glass Company
Glasstech Inc.
Keraglass
Landglass Technology
Mappi International
Mazzaroppi Engineering
SGLASS
Shanghai North Glass Technology

CHEMICALS TEMPERING EQUIPMENT
Glass Company
R.C.N. Solutions

ACCESSORIES
CNUD-EFCO
Deltamax Automazione
Fenzi
Glaston
Glass Company
Helios Quartz
Hornos Industriales Pujol
Keraglass
Landglass Technology
Mappi International
Mazzaroppi Engineering
R.C.N. Solutions
SGLASS
Tekno Kilns
Satinal - Strato - TK
Torgauer Maschinenbau

Bending

BENDING FURNACES (ARCHITECTURAL GLASS)
Glaston
Glass Company
Glasstech Inc.
Hornos Industriales Pujol
Keraglass
Mappi International
Mazzaroppi Engineering
R.C.N. Solutions
SGLASS
Tekno Kilns
Satinal - Strato - TK

BENDING FURNACES (AUTOMOTIVE GLASS)
CNUD-EFCO
Glaston
Glass Company
Glasstech Inc.
Keraglass
Mappi International
Mazzaroppi Engineering
R.C.N. Solutions

ACCESSORIES
Ayrox
Deltamax Automazione
Glaston
Glass Company
Glasstech Inc.
Hornos Industriales Pujol
Keraglass
Mappi International
Softeco
Tekno Kilns
Satinal - Strato - TK

Laminated glass production

COMPLETE PLANTS
Bovone Elett.
Bottero
Bystronic glass
Forel
Glaston
Glass Company
Hornos Industriales Pujol
IOCCO Group
Lisec Group
Mazzaroppi Engineering
R.C.N. Solutions
Triulzi

LAMINATED WINDSCREEN BENDING FURNACES
ECOL
Glaston
Glass Company
Glasstech Inc.
Keraglass
Mappi International

AUTOCLAVES
Bystronic glass
Glaston
Glass Company
Hornos Industriales Pujol
Lisec Group
Triulzi

CLIMATIC CABINS
Bystronic glass
Forel
IOCCO Group
Lisec Group
Triulzi

INFRARED OVENS
Bystronic glass
ECOL
Forel
Glass Company
Hornos Industriales Pujol
IOCCO Group
Lisec Group
SGLASS
Triulzi

PRESSES/BENDING MACHINES
Forel
IOCCO Group
Lisec Group
Triulzi

RESIN LAMINATING MATERIALS AND EQUIPMENT
IOCCO Group
Torgauer Maschinenbau

PVB
Everlam
Kuraray - Trosifol

PVB - SHAPING AND CUTTING EQUIPMENT
Ayrox
Bystronic glass
ECOL
Forel
IOCCO Group
Lisec Group
Softeco

PVB - WIRING TECHNOLOGY FOR HEATABLE LAMINATES
Ayrox
ECOL
Softeco

ACCESSORIES
Ayrox
Bottero
Deltamax Automazione
Glaston
Helios Quartz
Hornos Industriales Pujol
IOCCO Group
Lisec Group
Softeco
Triulzi

Drilling

AUTOMATIC DRILLING LINES
B Solution Licensee of BF Project
Bando Kiko
Bavelloni
Bystronic glass
Forvet
Guangdong Northglass & Juisun Technology Industrial
Intermac - Biesse
IOCCO Group
Schiatti Angelo
SKG - Skill Glass

MULTI-SPINDLE DRILLING MACHINES
B Solution Licensee of BF Project
Bando Kiko
Bavelloni
Bystronic glass
CMS
Forvet
Glass Company
Intermac - Biesse
IOCCO Group
Schiavo
Schiatti Angelo
SKG - Skill Glass

DRILLING MACHINES WITH OPPOSITE DRILLING HEADS
B Solution Licensee of BF Project
Bando Kiko
Bavelloni
Bottero
Bystronic glass
CMS
Fenzi
Forvet
Hiseng Glass Machinery
Intermac - Biesse
IOCCO Group
Schiavo
Schiatti Angelo
SKG - Skill Glass

COLUMN DRILLING MACHINES
B Solution Licensee of BF Project
Bottero
Fenzi
Schiavo

PORTABLE DRILLING MACHINES
CMS
Fenzi
Schiavo

DRILLING AND MILLING MACHINES
Bavelloni
Bottero
CMS
Forvet
IOCCO Group
Schiavo
SGLASS

DIAMOND DRILLS
ADI
Bovone Diamond Tools
Diamant - AR Nunziata
Diamut - Biesse
Fenzi
Glaston
Mole Moreschi
Schiavo
Tyrolit Vincent

ACCESSORIES
CMS
Fenzi
Schiavo

Other equipment and plants

TURNKEY PLANTS / ENGINEERING - FOR BUILDING GLASS
Bando Kiko
Bottero
Bystronic glass
Cugher Glass
Horn
Intermac - Biesse
IOCCO Group
Keraglass
Lisec Group
Torgauer Maschinenbau

TURNKEY PLANTS / ENGINEERING - FOR AUTOMOTIVE GLASS
Bando Kiko
Bottero
Bystronic glass
Cugher Glass
Easy Automation
Horn
Intermac - Biesse
IOCCO Group

KEY PLANTS / ENGINEERING - FOR DISPLAY GLASS
Bando Kiko
Cugher Glass
Torgauer Maschinenbau

WORKING CENTRES - CNC CONTROLLED
Bando Kiko
Bavelloni
Bottero
Bystronic glass
Glass Company
Glasstech Inc.
Hegla
Intermac - Biesse
SKG - Skill Glass

FLOAT PLANTS/LINES (EQUIPMENT & ACCESSORIES)
Bovone Elett.
Horn
IOCCO Group

CULLET HANDLING SYSTEMS
ECOL

COMPLETE BATCH PLANTS
Zippe

VACUUM COATING EQUIPMENT AND PLANTS
Glass Company
Shanghai North Glass Technology

ENAMELLING EQUIPMENT AND PLANTS
Giardina Finishing + HS Glassprinting
Glass Company
Rollmac division of GeMaTa

HOT- AND COLD-END COATING SYSTEMS AND MATERIALS (CVD, ROLLER, CURTAIN COATERS, DRYERS)
Giardina Finishing + HS Glassprinting
Goldglass Technologies

SANDBLASTING SYSTEMS, EQUIPMENT AND PLANTS - OPTIMIZERS
Fenzi
Fratelli Pezza
Glass Company
Schiavo
SKG - Skill Glass

DIGITAL INKJET PRINTERS
Glass Company

SCREEN PRINTING EQUIPMENT AND PLANTS
Ayrox
COMSS
Cugher Glass
Deltamax Automazione
ECOL
Giardina Finishing + HS Glassprinting
Glass Company
Guangdong Northglass & Juisun Technology Industrial
Keraglass
Rollmac division of GeMaTa
Shanghai North Glass Technology
Softeco

SCREEN PRINTING FRAMES
COMSS

SCREEN PRINTING DRYING SYSTEMS
COMSS
Cugher Glass
Glass Company
Guangdong Northglass & Juisun Technology Industrial
Rollmac division of GeMaTa

ACIDING GLASS EQUIPMENT AND PLANTS
Lisec Group
Rollmac division of GeMaTa

LASER DECORATING MACHINES
Ashton Industrial Sales
Glass Company

LASER MARKING
Ashton Industrial Sales

Artistic glass production

CERMAMIC INKS
Glass Company

CHAMBER ELECTRIC KILNS
Glass Company
Keraglass
Tekno Kilns
Satinal - Strato - TK

ACCESSORIES
Deltamax Automazione
Helios Quartz

Miscellaneous

AUTOMATION
Ashton Industrial Sales
Goldglass Technologies
Horn
IOCCO Group
Torgauer Maschinenbau
Zippe

AUTOMOTIVE GLASS APPROVAL SERVICES
Ayrox
Softeco

AUTOMOTIVE GLASS QUALITY CONTROL
Ayrox
Bando Kiko
Bystronic glass
Cugher Glass
Deltamax Automazione
Easy Automation
Glaston
IOCCO Group
Softeco

CE MARKING - QUALITY CONTROL EQUIPMENT FOR GLASS IN BUILDING
Ayrox
Softeco

COATING OF GLASS SHEETS - SYSTEMS & MATERIALS - HOT / COLD END
Goldglass Technologies

COLOURS & ENAMELS - OTHER APPLICATIONS
Ayro
Goldglass Technologies

DEIONIZING AND WATER SOFTENING EQUIPMENT
Fenzi
Forel
Glass Company
Idrotecnica
Lisec Group
Triulzi

FLAT GLASS QUALITY CONTROL DEVICES
Ayrox
Deltamax Automazione
Forel
IOCCO Group
Softeco

FURNACES
Glass Company
Horn

FURNACES / HYDROGEN GENERATORS (WATER ELECTROLYSERS)
Nel Hydrogen

GLASS COATING AND TINTING
Giardina Finishing + HS Glassprinting
Glass Company
Goldglass Technologies
Rollmac division of GeMaTa

GLASS TREATMENT FILMS
Glass Company

HEATING EQUIPMENT - STANDARD (GAS FIRING, BURNERS, AIR GAS MIXERS, SAFETY DEVICES, ELECTRICAL RESISTORS)
Horn
Keraglass

INFRARED TUBES
Helios Quartz
Deltamax Automazione

KILNS
Glass Company
Keraglass
Lisec Group
Tekno Kilns
Satinal - Strato - TK

METAL ACCESSORIES
Fenzi

METALLIC SECTIONS
Fenzi

NUMERICAL CONTROL SYSTEM (CNC) FOR ALL GLASS PROCESSING MACHINES
Glass Company
IOCCO Group
Prodim

OPTICAL DISTORTION ANALYSERS FOR AUTOMOTIVE GLASS
IOCCO Group
Keraglass

OPTICAL INFRARED THERMOMETERS
Optris

POWDER OR LIQUID APPLICATION SYSTEMS FOR PROTECTING FLOAT GLASS
Cugher Glass
Giardina Finishing + HS Glassprinting
Glass Company

PUMPING AND APPLICATION SYSTEMS (AUTOMOTIVE GLASS)
IOCCO Group

PURIFIERS FOR REFLUENT WATER
Dieffe Macchine
Forza G / G. Tech

PUTTIES AND SEALANTS
Fenzi

QUARTZ EQUIPMENT
Helios Quartz

SHAPE CHECKING DEVICES
Easy Automation
IOCCO Group

SIC HEATERS
Helios Quartz

SOFTWARE DATABASE, PROPERTY PREDICTOR
Synerglass Soft

SOFTWARE SYSTEMS FOR PRODUCTION CONTROL
A+W Software
CMS
Cugher Glass
Deltamax Automazione
Edgetech Europe
Forel
Lisec Group
Optima
Prodim
Synerglass Soft

SOLDERING EQUIPMENT FOR ELECTRICAL CONNECTORS FOR WINDSCREENS AND BACKLITES
Ayrox
Easy Automation
Softeco

SORTING SYSTEMS
Bystronic glass
Lisec Group

SURFACE STRESS MEASUREMENT INSTRUMENT
Ayrox
Glass Company
Jeffoptics

TESTING FOR SOLDERINGS
Ayrox
Easy Automation
Softeco

TESTING DEVICES OF BACKLITES ELECTRICAL HEATING
Ayrox
Softeco

THERMAL IMAGING SYSTEMS
Easy Automation
Glass Company
Optris

TIN FLOAT BATH FURNACES
Horn
IOCCO Group

UV LAMPS
Helios Quartz

UV PORTABLE MACHINES
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1989

Glass-Technology International

GLASS-TECHNOLOGY INTERNATIONAL is the leading international magazine for professionals involved in the flat and bent glass industry, from building to automotive, and from furniture to household appliances. **G-TI** is useful for those working in float glass plants as well as glass processors/fabricators, glazing contractors, automotive glass installers, window and door manufacturers, glass merchants, wholesalers, etc. With about 100 pages per issue, it is the bi-monthly tool for keeping abreast of new technology, new products, company life and all innovations in the world of flat and bent glass.

Annual Guides

1990

Glass Industry Directory 2020

The **GLASS INDUSTRY DIRECTORY** is a unique international annual guide which gives a complete overview of international glassworks and suppliers involved in hollowware and special glass manufacturing. About 300 pages of complete company profiles: addresses, management, sister companies, plants, number of employees, turnover, banks, year of company foundation, capital, trademarks, areas of activity, innovations, product-by-product and country-by-country breakdowns. The **GLASS INDUSTRY DIRECTORY** is the annual reference point for the international glass manufacturing industry comprising bottles and containers, domestic glassware, tubing, vials and ampoules, lighting glassware, technical and industrial glassware, scientific, laboratory and medical glassware and much more.

2013

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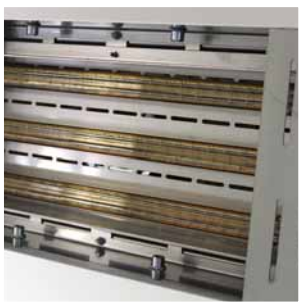
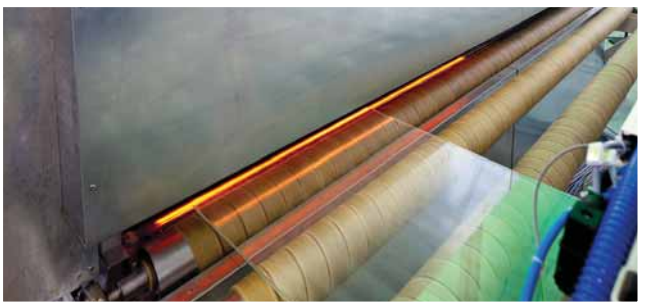
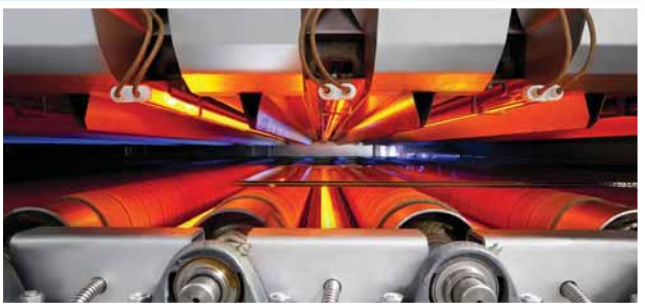
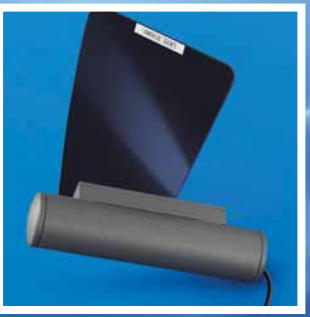
GLASS APPLICATIONS

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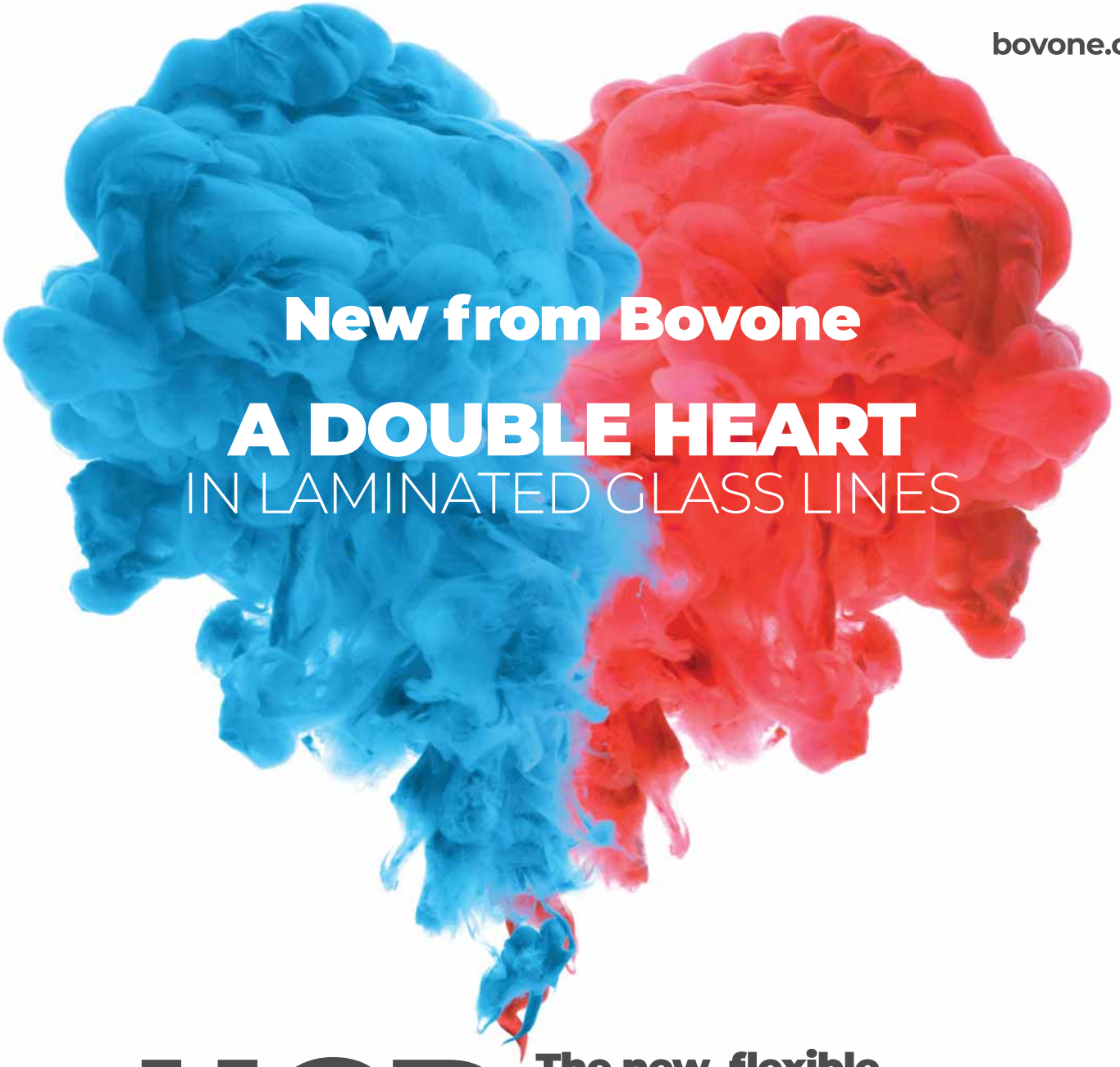

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